01-02-2023

M.Tech., Infrastructure Construction & Management (CIM)

(Effective from the Academic year 2022-23)

Program Outcome of this course: After successful completion of the program, the postgraduates will be able to

Sl. No.	Description	POs
1	Demonstrate a degree of mastery over material, design, construction, maintenance and management of infrastructure with due consideration to societal and environmental aspects.	PO1
2	Carry out experimental investigations/ research and development activities to solve real world problems related to infrastructure construction and management	PO2
3	Demonstrate / decipher knowledge about critical issues related to professional practices with special reference to procurement of work, contractual procedures, financial management and construction management	PO3
4	Adopt safe, economical, ethical and sustainable factors in design, construction and management of infrastructure	PO4`
5	Possess critical thinking, familiarity with computational procedures and problem solving abilities that are essential to infrastructure construction management	PO5
6	Use modern tools for design, analysis and management of infrastructure. Engage in life long learning for professional advancement	PO6
7	Write and orally present project/ technical report articulated in reasonably good English in the domain of infrastructure construction management	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team spirit and leadership qualities	PO8

01-02-2023

Semester- 1

Statistics and Numerical Analysis in Construction			
Course Code	**22CIM11**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	39 Hr. Theory	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to

- Develop analytical capability and to impart knowledge in Statisticalmethods
- Utilize knowledge of statistical methods & its applications in real world constructionproblems

Module-1

Introductiontostatisticalmethods:Definition,Scope,andLimitationsofStatistics.Variablesandtheirtypes.Types of data – Primary and Secondary data, sources of secondary data. Scales of measurement of data. Methods of collectionofdata.ReliabilityandAccuracyofdata.Presentationofdata-Tabularmethods(Frequencydistribution for both discrete and continuous data) and Graphical methods (Bar diagrams, Pie diagrams, Histogram – location of mode using Histogram, Frequency curves and polygons, Line graph, Ogive curve – location of median using ogives,Scattereddiagram.Advantageanddisadvantageofbothtabularandgraphicalmethods.Summarizingdata.

Measure of central tendency and Measures of dispersion/ variation. Merits and Demerits of measures of central tendency and dispersion. Measures of Skewness andKurtosis.

SDA: Group based assignment using excel to solve problems on frequency distribution, graphical methods, measures of central tendency and dispersion

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving

01-02-2023

Module-2	
Probability & Probability distribution for Traffic Engineering Design: Definition of Sample space, mutually exclusive, equally likely, independent outcomes, favorable events, Definitions of different types of probability, addition and multiplication rule of probability, conditional probability, Bayes theorem. Random variables, Definition of probability mass function (pmf) based on discrete random variable and probability density function (pdf) based on continuous random variable. Expected value and Variance of discrete and continuous random variables. Cumulative distribution function. Joint probability distribution. Special discrete probability distributions like Bernouli, Binomial and Poisson. Special continuous probability like Normal distribution and Standard normal distributions. Problems based on probability distributions. **SDA:** Group based assignment on finding probabilities of different distribution using excel.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving.
Module-3	
Sampling Techniques: – Definition of basics concepts of sampling, advantages and disadvantages of sampling, Probability and non-probability sampling techniques, Sampling variation. Definition of sampling distribution, sampling distribution of the sample mean (t-distribution), sample variance (Chi-square distribution), sample proportion(Z-distribution),ratioofsampletwosamplevariance(F-distribution)Centrallimittheorem,Sampling error, Sample size distribution.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving
Module-4	

01-02-2023

Statistical Inference: Basics of testing of hypothesis. Parametric tests: Z-test for mean and proportion, Students' t-test,F-test,AnalysisofVarianceNon-parametrictests:Chi-squaretest,Fisher'sexactprobabilities,Mann-WhitneyU test, Wilcoxon signed rank test, Kruskal-Wallistest SDA: Group based assignment on t-test and ANOVA using excel	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving
Module-5	
Basics: Summary of basic concepts of Matrices, Matrix Operations, Matrix inverse, Solutions of system of linear equation using Gaussian elimination, GaussianJordan, Gauss – Seidal methods Matrix Factorization: Cholesky Factorization, LU-factorization. Numerical Integration: General quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. TheSEE questionpaperwill besetfor100marksandthe marksscoredwillbeproportionatelyreducedto50.
2. The question paper will have ten full questions carrying equalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Books

1. Miller, Freund Hall, 'Probability and Statistics for Engineers', Prentice IndiaLtd.
2. PipesandHarvill,"AppliedMathematicsforEngineersandPhysicists",McGrawHillInternationalEdition.

Reference Books:

1. Sampling techniques Cochran, WileySeries.
2. Numerical methods, E. Balaguruswami, McGraw Hillpublication.
3. Numerical Methods: Problems & Solutions, Jain M K, Iyengar S R K, Jain R K, Wiley EasternLtd

Web links and Video Lectures (e-Resources):

- 1.https://nptel.ac.in/courses/110107080

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl.No.	Description	BloomsLevel
CO1	Understand the use of statistical tools to express the traffic data for better interpretation.	L2, L3
CO2	Applyprobabilityconcepttounderstandthevehicularflowbehaviourhelpingthe planners to predict trafficflow.	L3, L4, L5
CO3	Useappropriatestatisticaltestingtoolstocheckthedegreeofaccuracyinthetraffic dataanalysis.	L3, L4
CO4	Test the hypothesis and assess the error involved in thedataanalysis.	L2, L3, L4
CO5	UsesoftwaretoolslikeMATLAB,MINITABetc.,foranalysisoftrafficdataandalsouse curve fitting techniques for predicting the performance trends.	L4,L3

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1				x	x			
CO2		x		x	x			
CO3				x		x		
CO4					x			
CO5				x		x		

Semester – 1

CONSTRUCTION PROJECT MANAGEMENT			
Course Code	**22CIM12**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	39 Hr Theory + 26 Hr. Practice	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:
This course will enable students to
- Understand the various management techniques for successful completion of Constructionprojects.
- Understand the use, effect of management for projectorganization
- Understand Planning, scheduling and Resources allocation to project activities and use of relatedSoftware.

MODULE-1	
Scope, Meaning and Definition of Construction Project, Project Categories, Characteristics of Project, Project Life Cycle and Phases, Project Management Functions, Roles of Project Manager.	
Teaching-Learning Process	Studying on going Civil construction Projects and their respective company organisation. NPTEL lectures
MODULE-2	
Planning for Construction Projects, Principles of Planning, Objectives, Resource Planning, calculation and Allocation to activity, Scheduling, Productivity chart, Activity Duration Calculation, Project tracking, Risk Management	
Teaching-Learning Process	Use of Project Planner software and Group based assignment on preparing plan, schedules, productivity charts manually and through software.
MODULE-3	

Project Management through Networks, AOA & AON and Precedence Networks, CPM, Pert, Critical Path, Slack, Floats, Events (Start to Finish, Start to Start, Finish to Start, Finish to Finish), Probability of completion, Resource smoothening and resource levelling, Gantt Chart, Work Break Down Structure	
Teaching-Learning Process	Group based study on network like AOA, AON and Allocation of resources in project, Use of Project Planner software
MODULE-4	
Earned Value Management- meaning and definition, earned value, cost performance index, schedule performance index, cost variances, schedule variance, Final Cost, Final Project Duration	
Teaching-Learning Process	Group based study on effect of using Earned value Management in project and Its interpretation on results generated by EVM. Use of Project Planner software
MODULE 5	
Crashing of networks, Importance of Crashing of Network and its effect on project completion Time and Cost, direct cost, Indirect Cost, Normal cost, crash cost, cost-time optimization, Use of application software for Project Management.	
Teaching-Learning Process	Group based study on crashing of network, its uses in construction projects and effects

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Assignment on Listing of activities and Planning
2	Assignment on Preparation of productivity Chart

3	Assignment on Scheduling, Gantt Chart, Activity on Node, Event to Event Relation
4	Assignment on developing a precedence network, calculation of floats and project crashing.
5	Resource calculation and allotment to each activity – use of computational techniques
6	Assignment on Work Break down Structure – with case studies
7	Assignment on Updating activity Progress & Tracking– use of computational techniques
8	Assignment on Report Generation, Understanding Reports and Corrective actions - use of computational techniques
9	Assignment on using MS Excel, MS Project software software to be done
10	Assignment on any one software used - An estimation and tendering software /primavera software Students are required to operate the software;
11	Case study Example -Residential project
12	Site Visits Minimum Two site visits to study construction techniques and use of major construction equipment associated with ongoing major construction works. Visit Report to be submitted.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum

total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

1. Two Tests each of **20Marks**

2. Two assignments each of **10 Marks/One Skill Development Activity of 20marks**
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to **30marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of thesemester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15marks.
- Thelaboratorytestattheend/aftercompletionofalltheexperimentsshallbeconductedfor50marksand scaled down to 05marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2. The question paper will have ten questions. Each question is set for 20marks.
3. Therewillbe 2questionsfromeachmodule.Eachofthe twoquestionsunderamodule(withamaximumof3 sub-questions), **should have a mix of topics** under thatmodule.
4. The students have to answer 5 full questions, selecting one full question from eachmodule.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20marks.
- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in theSEE.Markssecuredwill bescaleddownto50.(Studenthastosecureanaggregateof50%ofmaximum marks of the course(CIE+SEE)

Suggested Learning Resources:

Books:

1. George.I. Ritz, (1994), "Total Construction Project Management", McGraw – HillInc.
2. Sengupta B., Guha M, (1998), "Construction Management and Planning", McGraw HillCompanies.
3. P S Gahlot, B M Dhir, “Construction Planning andManagement”
4. Punmia B.C. and Khandelwal K. K., (1989), "Project Planning and Control with PERT and CPM", Laxmi Publication IIEdition
5. A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – FifthEdition.
6. S.KeokiSears,RichardH.Clough,GlennA.Sears,“ConstructionProjectManagement:APracticalGuideto Field Construction Management”, John Wiley & Sons,2008

Web links and Video Lectures (e-Resources):

1. NPTEL – Project Management (Videos Lectures) by Department of Industrial Management engineering IIT Kanpur (link-https://archive.nptel.ac.in/courses/110/104/110104073/#)

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning.

1. Preparation of AOA & AON Networks and findingSlack/Float
2. Crashing of Network for theabove.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Demonstrate the capabilities related to project scheduling and planning.	L1, L2, L3
CO2	Use the modern tools related to project management,	L3, L4, L5
CO3	Apply the knowledge in resource, and cost management.	L1, L2, L3, L4, L5

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X							
CO2	X							
CO3		X	X	X	X	X	X	
CO4			X	X	X			
CO5						X	X	X

Semester- 1

ADVANCES IN CONCRETE TECHNOLOGY			
Course Code	**22CIM13**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	39 Hr. Theory + 26 Hr. SDA	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives:

This course will enable students to

- To study the properties of constituent elements ofconcrete.
- To study the properties of fresh and hardenedconcrete.
- To study properties of special types ofconcrete.

Module-1

Brief review on Concrete and Reinforcement

Cement–Fundamentals,production,tests,andtypesofcement.BriefreviewofConventionalConcrete,constituent materials, and admixtures (mineral andchemical).

Reinforcements: Manufacturing process, types, tests reinforcement steel as per IS Code.

SDA: Carryout experiments and prepare test reports on concrete and reinforcement using appropriate software/tools.

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving

Module-2	
Fresh properties of concrete Rheology of Fresh Concrete: Introduction, Factor affecting the rheology of concrete, Measuring the rheological parameters.AnalysisofFreshConcrete:BasicConcept-Buoyancy(oldBS1881)method-Constantvolume(RAM) method. SDA: Tests on rheology of fresh concrete using shear box.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving
Module-3	
Hardened properties of concrete Strength of Concrete: Relationship between cube and cylinder strengths, Relationship between compressive strength and tensile strength, Flexural strength of concrete, Concrete Bond Strength, Relation between compressive strength and modulus of elasticity. Microstructure of Concrete: General, Basic Concept - Interfacial Transition Zone (ITZ) effect on strength of concrete. SDA: Expose students to destructive and non-destructive tests on concrete cube and cylinder specimens and develop correlation between the values obtained using appropriate tools.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving
Module-4	

HSC & HPC High strength concrete, High performance concrete: Definition, Fresh & Hardened Properties, Applications. Ferro-cement: Definition, Fresh & Hardened Properties, Applications. SDA: Develop high-performance concrete mixes and prepare ferro-cement specimens in laboratory.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving
Module-5	
Special Topics Curing Methods: Steam curing, water curing, Curing compounds, Shotcrete: Definition, Wet mix and dry mix process, general use and advantages. Under water concreting: Introduction, Basic requirements. SDA: Group activity on accelerated strength methods of testing.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Books:

1. Neville A.M. “Properties of Concrete”- 5e, Pearson Education India Ltd., ISBN: 978-0273755807,2012.
2. Mehta P. Kumar & Monteiro, Paulo J.M., "Concrete Microstructure, Properties and Materials", 4e, McGraw Hill Education, ISBN: 978-9339204761,2017

References:

1. M. L. Gambhir, "Concrete Technology: Theory and Practice", 5e, Tata McGraw-Hill Education, ISBN: 978-1259062554,2017
2. Aminul Islam Laskar, "Concrete Technology", 1e, Laxmi Publications, ISBN:978-9381159620,2013.
3. John Newman and Ban Seng Choo, "Advanced Concrete Technology – Process", ISBN: 0750651059, Elsevier Ltd. 2003.
4. John Newman and Ban Seng Choo, “Advanced Concrete Technology Testing and Quality”, Elsevier Ltd, ISBN 0750651067,2003.
5. Edward G. Nawy, "Concrete Construction Engineering Handbook", 2e, CRC Press, ISBN – 9780849374920,2008.
6. Raina V.K., "Concrete for Construction", 2e, Tata-McGraw Hill Publishing Co. Ltd. New Delhi, ISBN: 978-8184047530,2009.
7. IS: 10262:2019 - Guidelines for Concrete Mix Design proportioning, BIS, New Delhi,2019
8. N Krishna Raju, “Design of Concrete Mixes”, 5e, CBS Publishers and Distributors Pvt Ltd, ISBN: 978-8123924670, 2018.
9. Current Literatures and relevant ISCodes

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/105106176
- https://onlinecourses.nptel.ac.in/noc19_ce20/preview

Skill Development Activities Suggested

- Preparation of concrete and testing its fresh and hardenedstate

Course outcome (Course Skill Set)

Sl. No.	Description	Blooms Level
CO1	To study the properties of constituent elements of concrete.	L1, L2, L3
CO2	To study the properties of fresh and hardened concrete.	L2, L3, L4
CO3	To study properties of special types of concrete.	L3, L4 , L5

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X	X					X	X
CO2	X	X	X			X	X	X
CO3	X	X		X	X		X	X

Semester- 1

HIGHWAY CONSTRUCTION TECHNOLOGY			
Course Code	**22CHT14/22CIM14**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hr. Theory + 26 Hr. SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to:
- Understand the various equipment used for road construction and difficulties associated with highwaydrainage.
- Select suitable equipment for preparation of subgrade in cutting or filling and also the preparation steps for base and sub-baselayers.
- Characteristics of different types of bituminous layers and design of bituminous surfacing along with safety aspects needed forroads.
- Design the base course thickness and selection of materials as base layer for CCpavements.
- Analyse the defects in road construction and general pavement failures withremedies.

Module-1

Plants and Equipment: Components of pavement structure, functions and requirements.
Plants and equipment: Excavators, graders, compactors, crushers, bituminous hot mix plants, cement concrete mixers, pavers - uses in road construction.

Teaching-Learning Process	Students can be taken to the construction site. Assignments can be given to evaluate the details of different types of equipment used in road construction
Module-2	
Construction of Subgrade and Subbase: Specifications and steps for construction of subgrade, subbase, quality control tests.Constructionofgranularlayers:Specificationsandstepsofconstruction,WBM,WMM,CRM,qualitycontroltests. ConstructionofBituminousLayers:Differenttypesofbituminouslayers,specificationsandconstructionofbituminous layers, quality controltests.	
Teaching-Learning Process	Students can be given the field assignment to evaluate the degree of compaction of different pavement layers. Practically involving them to observe the methodology of construction.
Module-3	
Construction of Cement Concrete Pavements: Specifications and steps for construction of DLC, Paving Quality Concrete pavements, quality control tests. SpecificationsandstepsforconstructionofWhitetopping,Interlockingconcreteblockpavements,qualitycontroltests. Safety during Construction: Safety aspects during construction and maintenance works, road safetyfurniture.	
Teaching-Learning Process	Students can be given the field assignments to make details note of How rigid pavements are constructed at the site. To make them understand the difference between DLC. PQC, Quality control checks, joints etc.

Module-4	
Drainage: Assessment of drainage requirements for the road, design of various drainage components, drainage materials, surface and sub-surface drainage system for roads, drainage of urban roads.	
Teaching-Learning Process	Ongoing projects field data can be given to evaluate the validity of the given type of drainage, its design or can be given assignment to redesign the drainage.
Module-5	
Maintenance and Rehabilitation of bituminous and concrete pavements: Routine and periodic maintenance, preventive andreactivemaintenancefordrainageandpavements,Preparationofexistingpavementforpatching,profilecorrection, special measures to deal with reflection cracks in pavement overlays, requirements for rehabilitation, recycling. Recycling of pavements- cold recycling, hot recycling, Full Depth Reclamation, road construction in water logged areas, design & construction of RE walls to beadded.	
Teaching-Learning Process	Field studies can be offered to the students to evaluate the pavement condition with respect to the distress, and to suggest suitable maintenance program.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reducedto 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Eachfullquestionisfor20marks.Therewillbetwofullquestions(withamaximumoffoursub-questions)from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Books

1. "HighwayEngineering",KhannaandCEGJusto,A.Veeraragavan,Revised10thedition,publishedbyNemChand&Bros, Roorkee,ISBN:978-81-85240-80-0.
2. Prithvi Singh Kandhal, "Bituminous Road Construction in India", ISBN: 978-8120352582.
3. Delatte N. J., Concrete Pavement Design, Construction, and Performance, CRC Press, Taylor & Francis Group,2014.

Reference Books:

1. MoRTH "Specifications for Roads and Bridge Works"- 2013 Fifth revision, Indian RoadsCongress.
2. MoRTH "Manual for Construction and Supervision of Bituminous Works"- 2001, Indian RoadsCongress.
3. MoRTH "Manual for Maintenance of Roads"- 1989, Indian RoadsCongress.
4. "Pavement Drainage- Theory and Practice", G.L. Shivakumar Babu, Prithvi S Kandhal, Nivedya Mandankara Kottayi, Rajib Mallick, A. Veeraragavan, CPCPress.
5. FreddyLRoberts,PrithviSKandhaletal,"HotMixAsphaltMaterials,mixturedesignandconstruction"-(2ndEdition), National Asphalt Pavement Association Research and Education Foundation, Maryland,USA.
6. National Asphalt Pavement Association "Hot Mix Asphalt Paving Hand book"- 5100 Forbes Boulevard, Lanhm, Mary Land,USA.
7. "Hand Book on Cement Concrete Roads"- Cement Manufacturers Association, NewDelhi.
8. Relevant IRCCodes

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/105101087

Skill Development Activities Suggested

- Site visits when construction isongoing
- Working on casestudies

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand the different types of equipment used in road construction and their importance at different stages ofconstruction	L2
CO2	Understand the construction procedures of sub grade, sub base and base course and bituminouslayersinflexiblepavement.Acquiretheknowledgeofqualitycontrolcheckson the materials before, during construction and afterconstruction	L2
CO3	Understand the construction of CC pavements, quality control checks, concepts of white toppingondistressedbituminouslayers.Alsointroducedtothealternatematerialsbeingin used instead of conventionalones.	L2
CO4	Understand the importance of drainage in highway construction, design of drainages under different pavement conditions and rain fall data	L2, L3
CO5	Understand the causes for pavement distress of both flexible and rigid pavements, implementing suitable remedial measures at the site.	L3, L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	x		x	x				
CO2			x		x			
CO3			x					
CO4			x		x			
CO5						X		

Semester- 1

PREFABRICATED STRUCTURES			
Course Code	**22CIM15**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hr. Theory + 26 Hr. SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
This course will enable students to
- Understand types and design principles of RC Prefabricated structures and its designprinciples
- Understand method of analysis and design of structuralelements

Module-1

Basic Definitions - Types of prefabrication - prefabrication systems and structural schemes-Prefabricated Elements – columns, beams, floor, roof, footing and wall panels.

SDA: Group activity - Prepare simple models on elements like slab, beam, and column to understand their behaviour in prefab structures.

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving

Module-2

Functional Design Principles: Modular coordination – Standardization - Disuniting, Diversity of prefabricates – Materialproperties-Production–Transportation–Erection-Codalprovisions-Lateralloadresistance-Location and types of shearwalls. SDA: Prepare simple building plan (prefab structure) using modular coordinate system.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving
Module-3	
Precast concrete Floors: Types of floor slabs – flooring arrangements, limit state Serviceability – Deflection, limit state of flexure- Ultimate strength calculations in shear and flexure. SDA: Prepare detailing of conventional slab, flat slab using appropriate tools.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving
Module-4	
Precast concrete Beams: Introduction - Types of beams – non composite and composite beams - design and detailing of R C precast non composite beams. Walls: Types of wall panels - load bearing wall- stability of wall panels – construction procedure of pre-cast walls. Different Types of joints-their behaviour and design – Leak prevention, Joint sealants. SDA: Prepare the detailing of conventional beams and column manually through sketches/appropriate software tools.	

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving

Module-5

Components of Industrial Building (Single-Storey) - Purlins, Principal Rafter, Roof Truss, Gantry Girders, Corbel, Column, Bracings.
Precast Reinforced Concrete Truss – General, Requirement for Design of Truss, Reinforcement as per IS: 3201-1988, Construction Sequence.
Purlins – Design Procedure only.
Pre – Cast Columns – Design Procedure only.
Corbel- General Consideration as per IS-456:2000, Initial Dimensioning of Corbels as per BS 8110, Design of Corbel - Step by Step Procedure as per BS 8110.

SDA: Visit to nearby site or pre-cast plant.

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Books

1. Hass, A.M. "Precast concrete design and Applications", Applied Science Publishers,1983.
2. "Handbook on Precast concrete for buildings", ICI Bulletin 02, Indian Concrete Institute,2016.

References

1. "National Building Code of India", BIS, New Delhi,2016.
2. Kim S Elliott, "Precast concrete structures", Butterworth Heinemann Publications, ISBN-0750650842,2002.
3. HubertBachmannandAlfredSteinle,"PrecastConcreteStructures",Berlin:Ernst&Sohn,ISBN:978-3433029602, 2011.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=FdbHC4sfqBo

Skill Development Activities Suggested

- Sitevisits
- Working on casestudies

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Distinguish pre-engineered buildings from conventional units.	L1, L2, L3
CO2	Understand general principles of pre-fabrication.	L2, L3, L4
CO3	Plan simple buildings using various types of prefabricated elements.	L4, L5

CO4	Design simple prefabricated elements	L4, L5
CO5	Outline the various phases involved in precast/prefabricated technology	L1, L2

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X		X	X			X	X
CO2		X	X		X	X	X	
CO3	X	X	X	X	X	X		
CO4	X	X	X	X	X	X		
CO5	X	X		X		X	X	

ResearchMethodologyand IPR			
CourseCode	**22RMI16**	CIEMarks	50
TeachingHours/Week(L:P:SDA)	3:0:0	SEEMarks	50
TotalHoursofPedagogy	40	TotalMarks	100
Credits	03	ExamHours	03

CourseLearningobjectives:

- Tointroducevarioustechnologiesofconductingresearch.
- Tochooseanappropriateresearchdesignforthechosenproblem.
- Chooseappropriatetoolfortheconductionofresearch.
- Toexplaintheartofinterpretationand theartof writingresearchreports.
- Toexplainvariousformsoftheintellectualproperty,itsrelevanceandbusinessimpactinthechangingglobalbusinessenvironment
- TodiscussleadingInternationalInstrumentsconcerningIntellectualPropertyRights.

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research,TypesofResearch,ResearchApproaches,SignificanceofResearch,ResearchMethodsversusMethodology,Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria ofGood Research, and Problems Encountered by Researchers in India.**Defining the Research Problem:** ResearchProblem,SelectingtheProblem,NecessityofDefiningtheProblem,TechniqueInvolvedinDefiningaProblem, AnIllustration

Teaching-Learning Process	Chalkandtalk/PPT/casestudy

Module-2	
Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your researchproblem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings,How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoreticalframework,Developingaconceptual framework,Writingaboutthe literaturereviewed. **Research Design:** Meaning of Research Design, Need for Research Design, Features of a Good Design, ImportantConceptsRelatingtoResearchDesign,DifferentResearchDesigns,BasicPrinciplesofExperimentalDesigns,ImportantExperimental Designs.	
Teaching-Learning Process	Chalkandtalk/PPT/casestudy/webcontent
Module-3	
Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample SurveyversusCensusSurvey,TypesofSamplingDesigns.**MeasurementandScaling:**QualitativeandQuantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources ofError in Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, MultidimensionalScaling, Deciding the Scale.**Data Collection:** Experimental and Surveys, Collection of Primary Data,CollectionofSecondaryData,SelectionofAppropriateMethodforDataCollection,CaseStudyMethod.	
Teaching-Learning Process	Chalkandtalk/PPT/casestudy/webcontent
Module-4	

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, TestStatisticsandCriticalRegion,CriticalValueandDecisionRule,ProcedureforHypothesisTesting,HypothesisTestingforMean,Proportion,Variance,forDifferenceofTwoMean,forDifferenceofTwoProportions,forDifferenceofTwoVariances,P-Valueapproach,PowerofTest,LimitationsoftheTestsofHypothesis.**Chi-square Test:** Testof Difference ofmorethanTwoProportions,Test ofIndependenceofAttributes,TestofGoodnessofFit,

CautionsinUsingChiSquareTests	
Teaching-Learning Process	Chalkandtalk/PPT/casestudy/webcontent
Module-5	

InterpretationandReportWriting: MeaningofInterpretation,TechniqueofInterpretation,PrecautioninInterpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report,Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing ResearchReports.**IntellectualProperty:**TheConcept,IntellectualPropertySystem in India,DevelopmentofTRIPSComplied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The GeographicalIndications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varietiesand Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets,Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales forProtection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation(WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right ofPriority,CommonRules,Patents,Marks,IndustrialDesigns,TradeNames,IndicationsofSource,UnfairCompetition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection ofLiteraryandArtisticWorks,BasicPrinciples,DurationofProtection,TradeRelatedAspectsofIntellectualProperty Rights(TRIPS) Agreement, Covered under TRIPS Agreement,Features of the Agreement, Protection ofIntellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, IndustrialDesigns,Patents, Patentable Subject Matter, Rights Conferred,Exceptions, Term of protection, Conditions onPatentApplicants,ProcessPatents,OtherUsewithoutAuthorizationoftheRightHolder,Layout-Designsof IntegratedCircuits,ProtectionofUndisclosedInformation,EnforcementofIntellectualPropertyRights,UNSECO.	
Teaching-Learning Process	Chalkandtalk/PPT

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. Theminimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of themaximum marks of SEE.A student shall be deemed to have satisfied the academic requirements and earned thecredits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sumtotaloftheCIE(ContinuousInternalEvaluation)andSEE(SemesterEndExamination)takentogether.

ContinuousInternalEvaluation:

1. ThreeUnitTestseachof **20Marks**
2. Twoassignmentseachof**20Marks**or**oneSkillDevelopmentActivityof40marks** toattaintheCOsandPOs

Thesumofthreetests,twoassignments/skillDevelopmentActivities,willbe**scaleddownto50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcomedefinedfor thecourse.

SemesterEndExamination:

1. TheSEEquestionpaperwillbe setfor100marksandthemarksscoredwillbeproportionatelyreducedto50.
2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Each full question isfor 20marks. There willbe two full questions(with amaximum of foursub-questions)from eachmodule.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.
5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

TextBooks:

1. *Research Methodology: Methods and Techniques*, C.R. Kothari, Gaurav Garg,New Age International,4th Edition,2018..DouglasEComer,"InternetworkingwithTCP/IP,Principles,ProtocolsandArchitecture,"PHI,6thEdition

2. *Research Methodology a step-by-step guide for beginners.* (For the topic Reviewing the literature under module2),RanjitKumar,SAGEPublications,3rdEdition, 2011.

ReferenceBooks:

1. *ResearchMethods:theconciseknowledgebase,* Trochim,AtomicDogPublishing,2005.

2. *ConductingResearchLiteratureReviews:FromtheInternettoPaper,*FinkA,SagePublications,2009.

WeblinksandVideoLectures(e-Resources):

- https://www.youtube.com/watch?v=A7oioOJ4g0Y&list=PLVf5enqoJ-yVQ2RXUl6mCfLPf3J_JUfoc

Courseoutcome(CourseSkillSet)

Attheend ofthecoursethestudentwillbeableto:

Sl. No.	Description	Bloom's Level
CO1	Conduct research independently	L2
CO2	Choose research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.	L2
CO3	Statistically interpret the data and draw inferences	L2

MappingofCOSandPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		X						
CO2		X						
CO3		X						

CIM LABORATORY - 1			
Course Code	**22CIML17**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:2:0	SEE Marks	50
Credits	02	Exam Hours	03

Course objectives:

This course will enable students to

- To learn principles of laboratoryexperiments
- To understand the importance of laboratory testing ofmaterials.

Sl.NO	Experiments
1	**Tests on Soil:** Grain size analysis - Wet sieve analysis, Index Properties (LL, PL, SL), FSI, Compaction Test, Shear Strength Test, CBR, UCS - Precautions
2	**Tests on Aggregates:** Shape Tests (Elongation, Flakiness Index & Combined Index, Angularity Number), Aggregate Impact Value, Los Angeles abrasion value test, Specific gravity & Water absorption test, Stripping value test, Polished stone value test, Sand equivalent test
3	Test son Fine Aggregates: Gradation (zonal classification), Fineness Modulus, Specific Gravity, Water Absorption, Bulk Density
4	Cement: Fineness, Specific Gravity, Specific Surface, Consistency, Setting Time, Strength, Soundness. Admixture compatibility and marsh cone test (Plasticiser dosage)
5	Concrete: Mix design of normal concrete as per IS 10262: 2019; Workability of concrete - Slump test, Compaction Factor test, Flow Table test and slump retention test.
6	Tests for compressive strength of concrete cubes/cylinder; Split Tensile strength of concrete cylinder and Flexural Strength of concrete beam, precautions.

7	Others: Physical properties of fillers (fly-ash and GGBS) – Specific Gravity, Fineness (Specific surface)

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

After studying this course, students will be able to:

- Determinethephysicalpropertiesofcement,fineaggregateandcoarseaggregatesinlaboratorythrough experiments
- Determine the fresh properties of concrete like Slump value, compaction factoretc.,
- Determine the hardened properties of concrete like Compression, Split tensile strength and Flexural Strength of concrete

Semester End Evaluation (SEE):

SEE marks for the practical course is **50 Marks**.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

- All laboratory experiments are to be included for practicalexamination.
- (Rubrics)Breakupofmarksandtheinstructionsprintedonthecoverpageoftheanswerscripttobestrictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examinersjointly.
- Evaluationoftestwrite-up/conductionprocedureandresult/vivawillbeconductedjointlybyexaminers.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be madezero.
- The duration of SEE is 03hours

Suggested Learning Resources:

Reference Books:

1. Khanna, S.K., Justo, C.E.G., and A.Veeraragavan, Highway Materials and Pavement Testing, Nem Chand and Bros, Roorkee,2015.
2. B C Punmia, Ashok Kumar Jain and Anil Kumar Jain, "Soil Mechanics and Foundations", 16e, Laxmi Publications, ISBN: 978-8170087915, New Delhi,2017.
3. M. S Shetty, A. K Jain, "Concrete Technology – Theory and Practice", 8e, S. Chand& Co. ISBN: 978-9352533800, 2018
4. Relevant IS Codes /standards.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=oD0qIR6PnlQ
- https://www.digimat.in/nptel/courses/video/105102012/L04.html

COURSE OUTCOMES:

At the end of the course the student will be able to:

Sl. No.	DESCRIPTION	BOs
1	Determine the physical properties of cement, fine aggregate, and coarse aggregates in laboratory through experiments	L2, L3
2	Determine the fresh properties of concrete like Slump value, compaction factor etc.,	L2, L3
3	Determine the hardened properties of concrete like Compression, Split tensile strength and Flexural Strength of concrete	L2, L3

Semester- 2

CONTRACT MANAGEMENT			
Course Code	**22CIM21**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hr. Theory + 26 Hr. SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
This Course will enable the students to
- Understand the various types ofcontracts
- Understand the use and effect of contracts in constructionindustry

Module-1

Module 1:

Introduction to contracts: Definitions, Essentials for a legally valid contract, Salient features of contract, discharging of a contract, Documents for an Engineering Contract; Types of contracts: Classification Based on Tendering Process, Economic Consideration, Applicability of the various types of contracts in Construction.

Teaching-Learning Process	Group based assignment on comparing contract documents of different Categories of project.

Module-2

Tendering process: Definitions, List of Documents, EMD, Security Deposit, Invitation for Tenders and sale of Documents, Preparation of Tender Documents and its submission, Receipt of Tender Documents and its opening, Evaluation of Tender and Award of contract–Letter of Award, Letter of Intent, Issues in tendering process: Preregistration, Pre-Qualification, Nominated Tendering, Rejection of Tenders, Repeat Orders, Revocation of Tenders, Unbalanced Bidding.	
Teaching-Learning Process	Group based study on preparing a contract agreement process for a given project.
Module-3	
Administration/Performance of contract: Responsibilities (Duties and Liabilities) of Principal & Contractor, Monitoring and Quality control/assurance, Settlement of claims – Advances, Bills, Extension for time, Extras & Variations, Cost Escalations. Security Deposit, Retention Money, Performance Bond, Liquidated Damages, Penalties, Statutory Requirements.	
Teaching-Learning Process	Group based study on listing roles and responsibilities of principal and Contractor for a contract.
Module-4	
Breach of contract: Definition and Classification, Common Breaches by – Principal, Contractor, Damage Assessment, Claims for Damages.	
Teaching-Learning Process	Group based assignment on case study of breaches.
Module-5	

Dispute resolution: General, Methods for dispute resolution–Negotiations, Mediation, Conciliation, Dispute Resolution Boards, Arbitration, Litigation /Adjudication by courts. Conciliation –Appointment of Conciliator, Role of Conciliator, Special Features of Conciliation Dispute Resolution Boards (DRB), Constitution of DRB, Functioning of DRB, Procedure for Hearings, Status of Award.	
Teaching-Learning Process	Group based assignment on preparing a contract document for a given project inclusive of DRB and its evaluating case studies

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Books

1. AlbettRobertW.,(1961/LatestEdition)"EngineeringContractsandSpecifications",JohnWilleyandSons, NewYork.
2. Patil B. S. (2009) "Civil Engineering Contracts and Estimates", UniversityPress.
3. John G. Betty (1993/ Latest Edition) "Engineering Contracts", McGrawHills.
4. Vasavada B. J., (1997), "Engineering Contracts and Arbitration", (Self Publication by Jyoti B.Vasavada).
5. VaidK.N.,(1998)"GlobalperspectiveonInternationalConstructionContractingTechnologyandProject Management", NICMAR,Mumbai
6. Prakash V. A., (1997) "Contracts Management in Civil Engineering Projects", NICMAR,Mumbai.

Web links and Video Lectures (e-Resources):

1. NPTEL Lecture Series Advanced Contracts, Tendering and PublicProcurement. https://archive.nptel.ac.in/courses/129/106/129106006/

Skill Development Activities Suggested

- Going through Contract Agreements of Public/Private ConstructionProjects.

Course outcome (Course Skill Set) At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Demonstrate the ability to carry out various aspects of contract management	L1, L2, L3
CO2	Implement various steps of contract management to a real-world contractual management scenario.	L1, L2, L3

CO3	Device methods and techniques to negotiate arbitration.	L1, L2, L3

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X	X	X					
CO2		X	X					
CO3				X				

Semester- 2

SPECIAL CONCRETES (IPCC)			
Course Code	**22CIM22**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	39 Hr. Theory + 26 Hr. Practice	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives:
This course will enable students to
- To study the properties of constituent elements ofconcrete.
- To study properties of special types ofconcrete.

Module-1

Salient features of concrete mix design as per Indian standard (IS: 10262:2019).
High Strength Concrete: Definition, Mix Proportioning as per IS 10262-2019, Properties and Applications.

SDA: Preparation of design spreadsheets of different Concrete Mixes.

Teaching-Learning Process	Black board teaching/PowerPoint presentations

Module-2

Light Weight Concrete: Introduction, Definition, types, Properties and Applications. Geo-polymer Concrete: Brief history of development, Definition, material characterization, mix proportioning, properties, and applications. SDA: Characterisation of light weight and geo-polymer concrete / blocks.	
Teaching-Learning Process	Black board teaching/PowerPoint presentations
Module-3	
Self-compacting concrete: Introduction, Materials, Mix design of SCC as per IS 10262-2019; Fresh Properties of SCC - Filling, Passing and Segregation resistance. Hardened Properties of SCC – Compressive strength, Production and transportation, Placement and SCC application. SDA: Group activity - Developing SCC mixes by other than IS method.	
Teaching-Learning Process	Black board teaching/PowerPoint presentations
Module-4	
Fiber-reinforced Concrete: Brief Introduction on FRC, Properties of fibres and matrices, Theoretical stress–strain curves in uniaxial tension, Fresh concrete and Hardened concrete, Applications. Roller Compacted Concrete: Introduction, Materials, Mix design as per IS 10262- 2019, Fresh and Hardened Properties of mass concrete. SDA: Group activity - Application of the fibers in construction materials.	

Teaching-Learning Process	Black board teaching/PowerPoint presentations

Module-5

Temperature controlled concrete, Architectural concrete: Introduction, properties, and applications.

Recycled concrete: Introduction, Properties of recycled aggregate, Methods of recycling and quality, Applications.
CLSM: Brief Introduction, Materials and Properties as per ACI 229R, Applications.

SDA: Group activity – Develop concrete for low strength applications using unconventional and recycled material.

Teaching-Learning Process	Black board teaching/PowerPoint presentations

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl. No	Experiments
1	Non-destructive test on concrete by: (Demonstration) (a) Rebound Hammer Test; (b) Ultrasonic Pulse Velocity Test; (c) Profometer
2	DLC – Fresh and hardened properties
3	PQC – Fresh and hardened properties
4	Concrete for major infra projects: Properties, considerations.

5	Normal Strength Concrete using Recycled Aggregates: Mix design, properties, and considerations.
6	FRC using fibers: Mix design, properties.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

1.Two Tests each of **20 Marks**

2.Two assignments each of **10 Marks/One Skill Development Activity of 20marks**

3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to **30marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated, and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of thesemester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuousevaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.

- The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1.The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2.The question paper will have ten questions. Each question is set for 20 marks.
3. Therewillbe2questionsfromeachmodule.Eachofthetwoquestionsunderamodule(withamaximumof3sub-questions), **should have a mix of topics** under thatmodule.
4. The students have to answer 5 full questions, selecting one full question from eachmodule.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory componentoftheIPCCshallbeforCIEonly.However,inSEE,thequestionsfromthelaboratorycomponent shallbeincluded**.**Themaximumof04/05questionstobesetfromthepracticalcomponentofIPCC,thetotal marks of all questions should not be more than the 20marks.

SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course (CIE+SEE)

Suggested Learning Resources:

Text Books:

1. A. M. Neville, “Properties of Concrete”, 5e, Pearson Education India, ISBN: 978- 8131791073,2012.
2. Mehta P. Kumar & Monteiro, Paulo J.M., "Concrete Microstructure, Properties and Materials", 4e, McGraw Hill Education, ISBN: 978-9339204761,2017.

References:

1. John Newman and Ban Seng Choo, “Advanced Concrete Technology”, ISBN: 0750651059, Elsevier Ltd.,2003
2. Dr. Edward G Nawy, “Concrete Construction Engineering Handbook”, 2e, CRC Press, ISBN: 9780849374920, 2008.
3. Joseph A. Daczko, “Self-Compacted Concrete by-Applying what we know”, 1e, CRC Press, ISBN: 978-0415590648,2012.
4. IS: 10262:2019 - Guidelines for Concrete Mix Design proportioning, BIS, New Delhi,2019.
5. ACI 229R - Report on Controlled Low-Strength Materials, June2013.
6. ASTM D 6103: Standard Test Method for Flow Consistency of Controlled Low StrengthMaterial.
7. CurrentLiteratures.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc22_ce09/preview
- https://onlinecourses.nptel.ac.in/noc19_ce20/preview
- https://onlinecourses.nptel.ac.in/noc22_ce58/preview

Skill Development Activities Suggested

- Cast of concrete specimens and testing physicalproperties

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Differentiate different properties of constituents of concrete and suggest suitable testing methods to establish the same.	L1, L2, L2
CO2	Demarcate essential properties of special type of concretes and be able to define their suitability.	L2, L3, L4
CO3	Implement mix design procedures appropriate to the kind of concrete chosen.	L4, L5

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X	X			X		X	X
CO2	X	X	X	X		X	X	
CO3	X	X	X		X	X	X	

Semester- 2

CONCRETE DURABILITY			
Course Code	**22CIM231**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hr. Theory + 26 Hr. SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to:

- Understand the elementary structure of concrete and its influence ondurability.
- Explain the physical deterioration mechanisms in concretematrix.
- List and explain the factors affectingdurability.
- Elaborate on the mathematical models and their role in simulation of durabilityparameters.
- Understand the materials that enhance the durability ofconcrete.

Module-1

Introduction to durability of concrete, Current scenario – National & International, Concrete characteristics affecting durability performance, Major deterioration phenomena, Attacks due to Sulphate, sea water, acids, Ettringite formation, ASR, Alkali-carbonate reaction, corrosion of steel. Transport mechanisms – Absorption, sorption, permeation etc.

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.

Module-2	
Ingredients of concrete & their characterisation for durability – Cements, SCMs, aggregates, water and admixtures – water-reducing, waterproofing, shrinkage reducing admixtures, corrosion inhibitors, polymer dispersions, retarders, accelerators, Construction process for improved durability. Durability provisions in Indian Standards.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.
Module-3	
Test methods for assessing durability of RCC systems – Classification criteria of the test methods, Tests to assess water penetrability, gas & chloride ion penetrability, tests to assess resistivity of concrete, tests to assess corrosioninitiationofsteelreinforcement–halfcellpotentialtestasperASTM,Electrochemicaltestmethods,Tests to assess sulphate attack, freezing & thawing, ASR, abrasion & erosion of concrete, In-situ tests on concrete to assessdurability	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.
Module-4	
Durability design and specification: Prescriptive vs Performance approaches, durability indicators, Limit states for durability & service life design approach.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.

Module-5	
Planning for durability – aspects for durability planning, exposure environment, material selection, planning the construction process, planning on on-site testing, acceptance criteria for durability parameters, Evaluation of in-situ testing methods – visual observation & documentation, NDT techniques, partially destructive testing – pull-out tests, core test, chemical tests, tests for reinforcement corrosion.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Books

1. MariosSutosos,Concretedurability:Apracticalguidetothedesignofdurableconcretestructures, Thomas Telford Publications,2010.
2. Handbook on Concrete Durability, ICI – TC/08-01, Indian Concrete Institute,2019.

Reference Books:

1. Tom Dyer, Concrete Durability, CRC Press,2014.
2. C L Page, M M Page, Durability of Concrete and Cement Composites, Wood Land Publishing,2007.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc22_ce58/preview

Skill Development Activities:

1. Conducting laboratory test to identify or to find the degree of deterioration in concrete component/specimen and presenting a technicalreport.
2. Preparingsurvey paperonmaterialselection/recenttrendsinimprovingdurabilityperformanceofconcrete

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Demonstrate a degree of knowledge over the micro-properties of concrete such as porestructure,transportprocessesandinfluencesofsuchpropertiesonthedurability ofconcrete	L1, L2

CO2	Identify the nature of deterioration that has taken place in the given concrete specimen/component. Using the knowledge and critical thinking on mechanisms and patterns of deterioration and to be able to solve and suggest the remedial measures.	L2, L3, L4
CO3	Use the knowledge of mechanisms of deterioration and recommend /conduct appropriate tests to determine the degree of degradation	L3, L4
C04	Criticallythinkandmodelthedeteriorationdependingonitskindandpatternsuchas chloride penetration, carbonation, and chloride induced corrosion using numerical techniques	L3, L4
CO5	Select suitable materials such as admixtures, additives, inhibitors, retarders, dispersion agents, and accelerators that would enhance the durability	L2, L3, L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X							
CO2	X		X					
CO3	X	X						
CO4	X	X						
CO5	X							

Semester- 2

DESIGN OF BRIDGE AND GRADE SEPARATED STRUCTURES			
Course Code	**22CIM232/22CHT232**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hr. Theory + 26 Hr. SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to

- Understand historical evolution of bridges and types ofbridges.
- Understandtheelementsofbridgedesigni.e,forcesonbridges,IRCloadingstandardsforroadand railwaybridges.
- Know in detail about flyovers, their types and related IRC code provisions on geometricaldesigns.
- Understand substructures, piers, abutments, andappurtenances.
- Explain the quality assurance, bridge inspection and healthmonitoring.

Module-1

Historical evolution of bridges, classification of bridges, conceptual bridge design, site investigation, preliminary data to be collected, preliminary drawings, economic span of a bridge, ideal bridge, location of piers and abutments, traffic projection, investigation report, importance of proper investigation.

Teaching-Learning Process	Black Board, Slides on Projector, Site Case Studies

Module-2	
Standard specifications for road bridges, clearances, loads to be considered, dead load, IRC standard live loads, other type of loads. General design considerations, minimum reinforcement in beams and slabs, concreting operations, pre-stressed concrete, notations for detailing concrete bridges, traffic aspects of highway bridges, aesthetics of bridges, relative costs of bridge components.	
Teaching-Learning Process	Black Board, Slides on Projector, Site Case Studies
Module-3	
Flyovers, differences between flyovers and bridges, necessity for flyovers, types of flyovers: over pass, trumpet type, diamond shaped, cloverleaf shaped, rotary type, and directional advantages and disadvantages of each. Factors to be considered while building a flyover. Geometric design features, land requirement, spacing, design vehicle, ramps, typical pier and abutment dimensions. Concepts of congestion factor and reduction factors. Landscaping of flyovers.	
Teaching-Learning Process	Black Board, Slides on Projector, Site Case Studies
Module-4	
Bridge substructures, Piers, abutments, foundation types. Bridge bearings, joints and appurtenances, functions rendered by bearings, types of bearings, expansion bearing, fixed bearing, elastomeric pot bearings, bearings for skewbridges,joints,expansionjoints,appurtenances,footpaths,handrails,drainagearrangements,wearingcourse, approach slab. Relevant IRCstandards.	
Teaching-Learning Process	Black Board, Slides on Projector, Site Case Studies
Module-5	

Construction of bridges, quality assurance of bridge projects, bridge construction inspection- data to be collected. Constructionofshortspanandlongspanbridges.Constructionofcontinuousconcretebridges.Formworkandfalse work for concrete bridges, numbering f bridges, bridge management system. Smart structural health monitoring (SSHM)of bridges. Components of SSHM. Types of monitoring and metrics of monitoring. IoT in bridge health monitoring.	
Teaching-Learning Process	Black Board, Slides on Projector, Site Case Studies

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Eachfullquestionisfor20marks.Therewillbetwofullquestions(withamaximumoffoursub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Books

1. Johnson Victor, Essentials of Bridge Engineering, 6th edition, Oxford and IBH publishing, New Delhi,2018.
2. T.R.Jagadeesh,MAJayaram,DesignofBridgeStructures,3rdEdition,PrenticeHallofIndia,NewDelhi,2020

References:

1. Ponnu Swamy, Bridge Engineering, Mc_Graw Hill Publishing, 3rd Edition,2017.
2. Jim J Jhao,D.E.Tonias, Bridge Engineering, 3rd edition, Mc_Graw Hil Publishing, New York,2017.
3. V.K.Raina, Concrete Bridge Practice, 4th Edition, Shroff Publishers,2014.
4. Asheesh Kumar, Bridge Engineering, 2nd Edition, Vayu Education India Publishing,2020.

Web links and Video Lectures (e-Resources):

https://onlinecourses.nptel.ac.in/noc22_ce63/preview

Skill Development Activities Suggested

- Group based studies and sitevisit

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Elaborate on conceptual bridge design, identify suitable bridge for a given scenario, and be able to prepare a suitable report upon doing site investigation.	L1, L2, L3
CO2	Demonstrate the knowledge on bridge loading standards and IRC-code provisions.	L1, L2, L3

CO3	Identify different types of flyovers and recommend particular type depending on the constraints.	L2, L3, L4
CO4	Differentiate between different types of bearings and recommend a suitable type of bearing.	L2, L3, L4
CO5	Explain construction methods for different types of bridges, and able to decide on suitable health Monitoring procedure	L2, L3, L4, L5

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X							
CO2	X		x					
CO3	X		x					
CO4	X		x					
CO5	X		x					

Semester- 2

GROUND IMPROVEMENT TECHNIQUES (PEC)			
Course Code	**22CIM233/22CHT233**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hr. Theory + 26 Hr. SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to:

- Introduce the various types of improvement methods of engineering propertiessoils
- Introduce the application of engineering methods to ground improvementprojects
- Basicknowledgeonvariousgroundimprovementtechniquesandtheirsuitabilityforvarioustypesofsoil conditions
- The skills of implementation of geotechnical knowledge in fieldsituations

Module-1

Introduction - Need and objectives of ground improvement, classification of ground modification techniques, trends in ground improvement, Engineering properties of soft, weak and compressible deposits; Principles of treatment; Methods of compaction: Blasting, dynamic consolidation, pre-compression and compaction piles.

Teaching-Learning Process	Blackboard teaching/PowerPoint presentations

Module-2	
Methods of dewatering: Open sumps and ditches, well point system, electro-osmosis, Vacuum dewatering wells; pre-loadingwithoutandwithsanddrains,stripdrainsandropedrains.Stabilization:Withadmixtureslikecement, lime,calciumchloride,flyashandbitumen.Methodsofsoilimprovement-limestabilizationandinjection;thermal, electrical and chemicalmethods.	
Teaching-Learning Process	Blackboard teaching/PowerPoint presentations
Module-3	
Soil reinforcement: Reinforcing materials, concept of confinement, Gabion walls; Dynamic consolidation, Vibroflotation, Pre-consolidation with vertical drains, Granular piles, Soil nailing, Anchors & Thermal methods.	
Teaching-Learning Process	Blackboard teaching/PowerPoint presentations
Module-4	
Improvement of Foundation Soils: (a) Improvement of granular soils: Terms used to describe degree of compactness – relative density, density ratio and degree of compaction; Methods-Vibration at ground surface, factors influencing roller compaction; deep dynamic compaction, vibro-compaction impact atdepth. (b) Improvementofcohesivesoils:Preloading,ordewatering,methodsofinstalling:sanddrains,drainwicks, electrical and thermal methods.	
Teaching-Learning Process	Blackboard teaching/PowerPoint presentations

Module-5	
Grouting:Materialsofgrouting,groutingtechniquesandcontrol;purpose,functions,typesofgrouts;soilbentonite - cement mix; Emulsions & solutions; grout injection methods; Geo-synthetics: types, functions & Classification of geotextiles.SpecificApplications:Bearingcapacityimprovement,reinforcement,Retainingwalls,embankmentetc.	
Teaching-Learning Process	Blackboard teaching/PowerPoint presentations

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Books

1. Manfred R. Hansmann, "Engineering principles of ground modification", McGraw Hill pub. Co., New York, ISBN: 978-0070272798,1991.
2. RobertM.Koerner,"ConstructionandGeotechnicalmethodsinFoundationEngineering",McGraw-HillPub.Co., New York, ISBN: 978-0070352452,1984.

References

1. Winterkornand Fang, "Foundation Engineering Handbook" - Van Nostrand Rein hold Co., New York,1975
2. ArisC.Stamatopoulos&PanaghiotisC.Kotzios,"SoilImprovementbyPreloading",JohnWiley&SonsInc.Canada, ISBN: 978-0471815938,1985.
3. P.PurushothamaRao,"GroundImprovementTechniques",2e,LaxmiPublications,ISBN:978-8131805947,2016

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/105105210

Skill Development Activities Suggested

- Visit to site where ground improvement techniques areadopted
- Laboratory tests on ground improvementtechniques

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	DESCRIPTION	BOs
1	Analyse the need for ground improvement in weak and soft soils with likely modifications to improve their performance.	L1, L2

2	Decide on suitable dewatering method in soils to improve their performance as highway material	L2, L3
3	Apply appropriate soil strengthening by stabilization techniques	L3, L4, L5
4	Evaluate the strengthening techniques by reinforcing bars or anchoring methods depending on the type of soil.	L3, L4
5	Use ground improvement techniques such as geo-synthetics or grouting for cohesive soils.	L2, L3

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	x	x		x	x	x	x	
CO2	x			x	x	x	x	
CO3	x	x		x	x	x	x	
CO4	x			x	x	x	x	

Semester- 2

SOIL MECHANICS FOR PAVEMENT ENGINEERS (PEC)			
Course Code	**22CHT234/22CIM234**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hr. Theory + 26 Hr. SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives: This course will enable students to

- Understand the properties and behavior as a highway material under the application of wheelloads.
- Understand and compare the shear strength of soil and stability of slopes when used as subgrade soil and embankment fills or cutslopes
- Understand the permeability characteristics of soils to design proper drainage system and various investigations required to assess the soilproperties.
- Understand the type and soil composition affecting the surface runoff and sub-surface water flow in order to design proper drainagesystem.
- Analyse lack of strength or instability problems in soils due to soil formation or any other reasons and propose suitable strengthening methods for thesame.

Module-1

Introduction: Soil Mechanics applications to Highway / Infrastructure Engineering. Soil formations, Types, Regional Soil deposits of India, Index properties, their determination, importance, various soil classification systems, HRB classification, problems on these.

Soil Compaction: Introduction, Lab Tests, Factors affecting, Structure & Engineering behaviour of compacted cohesive soil, Field compaction specifications, Field compaction control, Different types of Equipment used for compaction, their choice.

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, , data collection through field/site investigation, lab demonstration on certain experiments on properties of soil

Module-2

Shear strength of soil: Introduction, Importance, Measurements, shear strength of clay, Sand, Elastic properties of soil – Tangent, Secant modulus, Stress – Strain curves, Poisson's ratio, Shear Modulus.
Stability of slopes: Introduction, Types, Different methods of analysis of slopes for Øu+0 & C-Ø soil, Location of most critical circle, Earth dam slopes stability, Taylor's stability number. Effect of Earthquake Force, problems on above.

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, , data collection through field/site investigation ,

Module-3

Permeability of soil: Darcy's Law, Validity, Soil-water system, Types, Determination of permeability, problems.
Site Investigation: Introduction, Planning exploration programmes, Methods, Samplers, SPT, Subsoil investigation Report, Geophysical methods.

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, data collection through field/site investigation, application of modern equipment's for field studies and laboratory studies

Module-4

Special attention for subgrade condition: Problematic soils, compressible &collapsible soils, swelling, subsurface water, frost-susceptible soils.
Surface drainage, Sub-surface drainage, methods, Design of subsurface drainage system, soil stabilization, soil encapsulation. Base layer requirement-erodibility of bases, bound bases, modified or treated bases, base reinforcement

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation, application of modern equipment's for field studies and laboratory studies
Module-5	
Reinforced Earth structures Introduction, Components, Advantages, Types of stability – external, Internal, (No problems), Geo textiles – types, Functions, their uses in road embankments and railway works, other uses. Landslides – definition, classifies, factors producing.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, laboratory studies.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not lessthan50%(50marksoutof100)inthesumtotaloftheCIE(ContinuousInternalEvaluation)andSEE(SemesterEndExamination) taken together.

Continuous Internal Evaluation:

1.Three Unit Tests each of **20 Marks**

2.Two assignments each of **20 Marks or one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Text Books:

1. "Basic and Applied soil Mechanics", Gopal Ranjan, ASR Rao, New Age International Publishers.
2. "SoilMechanics&FoundationEngg",Dr.B.C.Punmia,AshokKumarJain,ArunKumarJain,LaxmiPublications(P)Ltd,16th edition.
3. S.K.Khanna,C.E.GJustoandA.Veeraragavan,"HighwayEngineering"-NemChandandBros.,Roorkee.Revised10thEdition.

Reference Books:

1. "Geotechnical aspects of pavement reference manual", US department of transportation, Publication no: FHWA NHI-05-037, Federal Highway Administration, May 2006, NHI courseno:132040
2. "Soil Mechanics & Foundation Engg" – K.R. Arora Standard PublishersDistributors.

3. “Soil Mechanics for road Engineers” – HMSO, London. IRC – Relevant Codes.
Web links and Video Lectures (e-Resources):
• https://youtu.be/V1m3cB-Aqy8 • https://youtu.be/ldNt_O1obP0 • https://nptel.ac.in/courses/105103097
Skill Development Activities Suggested • Data collection through siteinvestigation • Carrying out field tests and laboratorytests

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	BloomsLevel
CO1	Able to understand different types of soil and their basic properties, analyse thewheelload effects on pavementmaterials	L1, L2, L3, L4
CO2	Evaluate and compare the shear strength of soil and stability of slopes whenusedas pavement component.	L1, L2, L3, L4, L5
CO3	Design proper drainage system by knowing the permeability characteristicsofsoils.	L1, L2, L3, L4
CO4	Design surface runoff and sub-surface drainage system as perfieldconditions	L1, L2
CO5	Proposesuitablestrengtheningmethodsforsoilfromtheknowledgeoflackofstrengthor instability insoils.	L2, L3

Mapping of COS and POS

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X		X			X	X	X
CO2	X		X		X	X	X	
CO3	X	X	X		X	X		
CO4	X	X	X		X	X		
CO5	X		X		X	X	X	

Semester- 2

CONSTRUCTION & DEMOLITION WASTE MANAGEMENT (PEC)			
Course Code	**22CHT235/22CIM235**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hr. Theory + 26 Hr. SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives: This course will enable students to

- Focus on the principles of sustainable construction and demolition waste management and resourceefficiency
- Examining the environmental impact of buildingmaterials.
- Formulating and designing pre–construction and site waste managementplans

Module-1

EnvironmentalImpactofBuildingMaterialsEmbodiedenergyofmaterials;impactonthelocalenvironment;toxicityof the material; life cycle assessment. Nature and Source Direct and indirect waste; site types and origins; composition; quantity;currentrecycling/reuse potentialofbuildingmaterials.

Teaching-Learning Process	Blackboard teaching/PowerPoint presentations (if needed)

Module-2

Construction and Demolition Waste Management Plans International good practice; planning requirements; DoEHLG guidance document; company policy; demolition plans; site implementation; supplier agreements; sub–contractor management; role of waste management contractor; training; auditing; skip management; current markets; current disposal options; health and safety; reporting to local authorities. TreatmentofConstructionandDemolitionWaste,wastepermits;wastelicenses;wastetransferfacilities;landfills; treatmenttechnologies;hazardouswastefacilities;reportingtoEPA	
Teaching-Learning Process	Blackboard teaching/PowerPoint presentations (if needed)
Module-3	
DesigningforWastePreventionandMinimization,Wastepreventionandminimization;client,contractoranddesigner attitudes; proper maintenance of existing buildings; reuse of existing building structure; design flexibility; design for reuseandrecycling;dimensionalco–ordinationandstandardization;modulardesign;materialselectionandcontrol.	
Teaching-Learning Process	Blackboard teaching/PowerPoint presentations (if needed)
Module-4	
Waste Forecasting Tools Application of WRAP's designing out waste tool for buildings and civil engineering; WRAP net waste tool; BRE SMART Waste; WRAP Site Waste Management Plan Tracker.	
Teaching-Learning Process	Blackboard teaching/PowerPoint presentations (if needed)
Module-5	
Future developments Potential future markets; ‘smart' materials; use of eco–materials.	
Teaching-Learning Process	Blackboard teaching/PowerPoint presentations (if needed)

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1.Three Unit Tests each of **20Marks**

2.Two assignments each of **20 Marks or one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Text Books:

1. Springer, "Recycling and Resource Recovery Engineering", Springer – Verlag, Berlin Heidelberg(1996)
2. Greg Winkler, "Recycling Construction and Demolition waste: A LEED - Based Toolkit (Green Source)", 1e, McGraw Hill Professional, ISBN: 978-0071713382,2010.

Reference Books:

1. V M Tam, Chi Ming Tam, "Reuse of Construction and Demolition Waste in Housing Development", Nova Science

Publishers, ISBN: 9781604563627, 2008.
2. JMPQ Delgado, "Sustainable Materials in Building Construction", Volume 11, Building Pathology and Rehabilitation, Springer, ISBN 978-3-030-46799-9 ISBN 978-3-030-46800-2 (eBook),2020
3. CurrentLiterature.

Web links and Video Lectures (e-Resources):

- http://www.digimat.in/nptel/courses/video/105105160/L48.html

Skill Development Activities Suggested

- Visit to Recycleplants.
- Studies of International standards on wastemanagement

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Understand the basic concept of embodied energy of construction materials.	L2, L3, L4
CO2	Understand the application of construction and demolition waste to various concrete structures	L3, L4

Program Outcome of this course:

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	x		X							
CO2	x		X	X						

Semester- 2

PAVEMENT MANAGEMENT SYSTEM (PEC)			
Course Code	**22CHT241/22CIM241**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hr. Theory + 26 Hr. SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives: This course will enable students to

- learn evaluation and prediction of pavement performance, to learn Ranking and economic optimization of pavement maintenance and rehabilitation and management.

Module-1

Introduction: Components & principals of pavement management systems, pavement maintenance measures, planning investment, research management. Pavement Management Data Needs, Inventory Data Needs, Project level and network level data needs Structural and functional requirements of flexible and rigid pavements. Pavement Distress survey and different types of failures in pavements.

Evaluation of Pavement Surface distress condition surveys – purpose, methods- manual and automated, types of distress, distress survey procedures, equipment used,

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving , data collection through field/site investigation.

Module-2

Functional Evaluation of Pavements:

Importance of pavement evaluation, functional condition evaluation techniques, network, project level, roughness measurement methods, Identification of uniform sections, serviceability concepts, visual and rating procedures, data collection technologies, pavement deterioration, factors affecting pavement deterioration, modelling, and comparison of different deterioration models.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation, application of modern equipment's for field studies
Module-3	
Structural deterioration of pavements: causes, effects, methods of treatment. Structural evaluation of flexible pavements by rebound deflection method, analysis of data, design of overlay, use of FWD and other methods for evaluation of flexible and rigid pavements and their application.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation, application of modern equipment's for field studies and laboratory studies
Module-4	
Evaluation of new pavement materials, model studies, pavement testing under controlled conditions, accelerated testing and evaluation methods, Test track studies. Instrumentation for pavement testing.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation, application of instrumentation for pavement testing through test track / Case studies

Module-5

Rehabilitation: Introduction, benefits of recycling, methods, recycling strategies, cold milling, ripping, crushing, recycling batch plant, drum mix plant, mix design, hot in place recycling techniques, cold in place recycling, full-depth reclamation, and current practices for improving riding quality.

Ranking and optimization methodologies, life cycle costing

Expert systems and Pavement Management: Role of computers in pavement management, applications of expert systemsformanagingpavements,expertsystemforpavementevaluationandrehabilitation,knowledge–basedexpert systems, casestudies.

Implementation of Pavement Management Systems.

Use of software: HDM-4/dTIMS

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, Pavement asset management using modern software

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1.Three Unit Tests each of **20 Marks**

2.Two assignments each of **20 Marks or one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1.The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2.The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Books:

1. Ralph Hass, W.Ronald Hudson with Lyne Cowe Falls., "Pavement Asset Management"-Scrivner Publisher, copyright2015
2. Ralph Hass, W. Ronald Hudson. W. R., Zaniewisti .J. "Modern Pavement Management" – Krieger Publishing Company, Florida,1994.

Reference Books:

1. Proceedings of North American Conference on ManagingPavement.

2. Proceedings of International Conference on Structural Design of AsphaltPavements.
3. NCHRP, TRR and TRB SpecialReports.
4. Freddy L Roberts, Prithvi S Kandhal et al, "Hot Mix Asphalt Materials, mixture design and construction"-(2nd Edition), National Asphalt Pavement Association Research and Education Foundation, Maryland,USA.
5. Highway Hand Book by FAW, Publication from NUS,Singapore.
6. Nicholas J.Garber, Lester A. Hoel, "Traffic and Highway Engineering", Third Edition Thompson Learning
7. IRC 81, 1997, GUIDELINES FOR STRENGTHENING OF FLEXIBLE ROAD PAVEMENTS USING BENKELMAN BEAM DEFLECTIONTECHNIQUE
8. IRC SP 16, 2004 Guidelines for Surface Evenness of HighwayPavements

Web links and Video Lectures (e-Resources):

- https://youtu.be/hiAmA74ya-o

Skill Development Activities Suggested

- Assessing pavement surface condition for a selected stretch of a road (Visual Road inventorysurvey)
- Demonstration on portable pendulum skid resistance tester for measuring skid resistance and dataanalysis
- Data Analysis from Structural and Functionalevaluation
- Use of computer applications likeHDM-4/dTIMS.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Understand the structural and functional requirements of pavements, components of PMMS and pavement surface	L1, L2, L4

CO2	Functional condition evaluation, condition survey, pavement deterioration modelling	L5, L3, L4
CO3	Structural evaluation –BBD and FWD analysis	L5, L3, L4
CO4	Evaluation of new pavement materials, model studies,	L5, L3, L4
CO5	Recycling strategies, life cycle cost, Expert system and pavement management	L4, L5, L6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X	X	X				X	X
CO2	X	X	X		X	X	X	X
CO3	X	X	X	X		X		X
CO4	X	X		X	X			
CO5	X	X	X	X	X	X	X	

Semester- 2

LOW VOLUME ROADS ENGINEERING (PEC)			
Course Code	**22CHT242/22CIM242**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hr. Theory + 26 Hr. SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives: This course will enable students to

- To understand the factors affecting pavement design and performance of RuralRoads.
- TorelatetheconceptsofHighwayGeometric designtothatofRuralroads
- TodesigntheSpecialpavementswhichformalternativesforRuralRoads.
- To understand the concepts of design of drainage, CD works and small bridges which form essential structures of Ruralroads

Module-1

Introduction to Low-Volume Roads (LVR). Significance of LVR, Definition, Design Environments. Planning of rural road, planning data base, concept of network planning Rural roads plan, guidelines laid down in recent 20 year plans and in PMGSY Road alignment and surveys, governing factors for route selection Factors controlling alignment; obligatory points, traffic , geometric designs, economy, special considerations in hilly areas.

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.

Module-2	
Geometric design standards: classification of rural roads, terrain classification, design speed, basic principles of geometric design cross sectional elements, camber, sight distances Horizontal alignment: general guidelines, super elevation, transition curve, widening and set back distances, vertical alignment: gradient, grade compensation at curves, valley	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation
Module-3	
Soil and material surveys, soil investigations for low embankment, high embankment, cut sections, subgrade, Survey for marginal materials and aggregates/ low grade materials Artificial aggregates, waste materials, new materials and stabilizers Design parameters, pavement components Design of flexible pavement: pavement thickness, pavement surfacing Design of semi rigid pavement: dry lean concrete / lime fly ash concrete bases Design of rigid pavement: cement concrete pavement Design of special pavements: concrete block pavement , interlocking concrete block pavement Choice of pavement type and materials, maximize use of Locally available materials, Use of Geo-synthetics in LVR	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.
Module-4	

Types of road drainage, requirements of surface drain; roadside drains, shoulder drains, catch water drains. Requirements subsurface drain Cross drains; types, requirements, choice of different types of cross drains Standard designs of culverts Standard design of small bridges.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving
Module-5	
Selection of materials and methodology, construction techniques, machinery, and tools. Construction of Embankment / subgrade; materials, requirements, and construction operations. Choice and requirements of coarse sand sub base, gravel roads. Innovative technology for Low volume roads. Pavement Maintenance and Rehabilitation Management System (RMS) for LVR. Unpaved, climate resilience LVR.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1.Three Unit Tests each of **20Marks**

2.Twoassignmentseachof**20MarksoroneSkillDevelopmentActivityof40marks**toattaintheCOsandPOs The sum

of three tests, two assignments/skill Development Activities, will be **scaled down to 50marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Text Books:

1. S.K. Khanna, C.E.G Justo and A. Veeraragavan, "Highway Engineering"- Nem Chand and Bros., Roorkee. Revised 10th Edition.
2. Robert A. Douglas, Low-Volume Road Engineering, Design, Construction, and Maintenance, I edition, CRCPress

Reference Books:

1. IRC: SP:72-2015, Guidelines for the design of Flexible Pavements for Low Volume roads FirstRevision
2. IRC: SP:62-2014, Guidelines for Design & Construction of CC pavements for low volumeroads
3. IRC SP 20 Rural RoadsManual

4. Relevant IRCPublications

Web links and Video Lectures (e-Resources):

- http://omms.nic.in/

Skill Development Activities Suggested

- Understand the PMGSY's three-tier Quality Control & Quality Monitoringmechanism.
- Visit nearby roads constructed under PMGSY scheme and evaluate the performance over a period oftime.
- Study the various technology demonstration projects executed underPMGSY

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Get the knowledge of factors affecting pavement design and performance of rural roads	L2
CO2	The student will be able to differentiate the design and construction of Low volume rural roads with that of the Highways	L2, L3
CO3	The students will be able to infer and review the DPRs prepared for construction	L2, L3, L4

Program Outcome of this course: After successful completion of the program, the postgraduates will be able to

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1					X			
CO2			X		X			
CO3		X			X	X		

Semester- 2

EARTHQUAKE RESISTANT STRUCTURES			
Course Code	**22CIM243**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hr. Theory + 26 Hr. SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to:

- Understand the fundamental aspects ofseismology.
- Explain the nature of ground motion and its severaleffects.
- Elaborate on basic elements of earthquake resistant design of structures and effects ofvibration
- Explainthemethodsadoptedtoidentifydamagesinvariouskindsofstructures/componentsduetoearthquake.
- List and explain various kinds of irregularities in structures and theireffects

Module-1

Engineering seismology, Introduction, plate tectonics, lithospheric plates, the movement of Indian plate, seismic waves, body waves, surface waves, Raleigh waves, love waves, earthquake size, intensity scale, isoseismal map, earthquake magnitude, Richter's magnitude, energy released in an earthquake, earthquake frequency, local site effects,lateraldiscontinuityeffects,seismotectonicofIndia,classificationofearthquakes,Tsunamianditsvelocity, runup andinundation.

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.

Module-2

Seismic zoning of India, seismic hazard zone map, nature of ground motions, Source Effect, Rupture directivity effect,Flingeffect,Hangingwalleffect,siteeffect,referencesiteapproach,non-referencesiteapproach,estimation of ground motion parameters, Indian perspective, utilization of strong motiondata.

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.

Module-3

Earthquake and vibration effect on structures, introduction, basic elements of earthquake resistant design. Static and dynamic equilibrium, structural models- structural models for frame buildings, seismic methods of analysis, code-based procedure, seismic design methods, response control concepts, earthquake protective systems, passive and active systems, seismic evaluation, and retrofitting,

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.

Module-4

IdentificationofseismicdamagesinRCbuildings,introduction,RCCbuildingconstructionpractices,identificationof damage in RC buildings, soft story failure, floating columns, plan and mass irregularity, poor quality of construction material and corrosion, pounding of buildings, inconsistent seismic performance of buildings, damages in non-structural elements, infill walls, exterior walls, damage to other kind of structuralcomponents.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.
Module-5	
Effect of irregularities on the performance of RC buildings during earthquake, vertical irregularities, vertical discontinuities, irregularities in strength and stiffness, mass and vertical geometric irregularity, proximity of adjacent buildings, plan configuration problems, torsion irregularities, re-entrant corners, recommendations	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Books

1. P Agarwal and M Shrikande, "Earthquake Resistant Design of Structures", Prentice Hall (India) Ltd, New Delhi, ISBN: 9788120328921,2006.
2. S.K.Duggal,"EarthquakeResistantDesignofStructures",2e,OxfordUniversityPress,NewDelhi,ISBN:978-0198083528,2013.

Reference Books:

1. Damodaraswamy S. R and Kavitha. S, "Basics of Structural Dynamics and Aseismic Design", PHI Publication, 1e, ISBN: 978-8120338432, 2009.
2. Vinod Hosur, Earthquake Resistant Design of Building Structures, Willy Publications,2017.
3. James Kelly, Earthquake resistant design with Rubber, CBS Publishers,2011.
4. IS 1893 (Part I): 2016, IS 13920-2016, IS 4326:2013,
5. IS 13828: 2013 and other relevantcodes.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/105101004

Skill Development Activities Suggested

1. Preparing a survey paper on appropriate techniques for building earthquake resistantstructures.
2. Presenting technical seminars on various topics (beyond the syllabus) related to earthquake resistant structures

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level

CO1	Demonstrate a degree of knowledge over the seismology related aspects like seismic waves, intensity scales, the quantum of energy released and the consequent effects on structures.	L1, L2
CO2	Identify the seismic zones from zone maps. Be able to determine various effects and ground motion parameters.	L2, L3
CO3	Use the knowledge of various models' various structures and be able to suggest earthquake protective system suitable to given situation. Also, to evaluate the seismicity and suggest suitable retrofitting methods	L1, L2, L3, L4
C04	Identifythenatureanddegreeofdamageandfindthereasonsforthedamageandalso find the seismic performance of the building.	L3, L4, L5
CO5	Identify various kinds of irregularities that may arise aftermath of earthquake and damages to buildings in the proximity.	L3, L4, L5

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X			X				
CO2	X			X				
CO3	X			X				
CO4	X			X				
CO5	X			X				

Semester- 2

STRUCTURAL MASONRY AND ALTERNATE BUILDING MATERIALS			
Course Code	**22CIM244**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hr. Theory + 26 Hr. SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
This course will enable students to:
- Understand masonry materials and its mechanicalproperties
- Analyze the behavior of structuralmasonry
- Demonstrate testing, analysis and designmethodologies
- Summarize construction practices, specifications, and inspection of masonrybuildings

Module-1

Introduction, Masonry units, materials and types: History of masonry, historical buildings, Masonry arches, domes and vaults: Components, classification and construction procedure.

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.

Module-2

Characteristicsofmasonryconstituents:Typesofmasonryunitssuchasstone,bricks,concreteblocks,clayblocks, adobe and stabilized mud blocks. Properties of masonry units like strength, modulus of elasticity and water absorption. Provisions of relevant IS codes on properties of masonryunits. Masonry mortars – Classification and properties of mortars, selection of mortars.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.
Module-3	
Strength of Masonry in Compression: Behaviour of Masonry under compression, strength and elastic properties, factors influencing of compressive strength masonry, Effects of slenderness and eccentricity, water absorption, curing, ageing and workmanship on compressive strength. Prediction of strength of masonry in Indian context.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.
Module-4	
Shear and Flexure Behaviour of Masonry: Bond between masonry unit and mortar, test methods for determining flexural and shear bond strengths, test procedures for evaluating flexural and shear strength, factors affecting bond strength, effect of bond strength on compressive strength, flexure and shear strength of masonry. Concept of Earthquake resistant masonry buildings.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.

Module-5	
Design of load bearing masonry buildings: concept of basic compressive stress, Permissible compressive stress, reduction factors. Increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses, Effective height of walls and columns, opening in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action, lintels; Wall carrying axial load, eccentric load with different eccentricity ratios, wall with openings, freestanding wall.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, data collection through field/site investigation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

3. Three Unit Tests each of **20Marks**
4. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

6. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
7. The question paper will have ten full questions carrying equalmarks.
8. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from eachmodule.
9. Each full question will have a sub-question covering all the topics under amodule.
10. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Books

1. HendryA.W.,"StructuralMasonry"-PalgraveMacmillanMacmillanEducationLtd.,2e,ISBN10:0333733096ISBN 13:9780333733097, 1998.
2. Jagadish K S, "Structural Masonry", I K International Publishing House Pvt. Ltd., ISBN 10 - 9384588660, ISBN 13: 978-9384588663,2015.

Reference Books:

1. W. Robert G Drysdale; Ahmad A Hamid, Masonry structures: Behavior and Design. Boulder, CO: Masonry Society, 3e, ISBN: 1929081332; ISBN: 978- 1929081332,2008.
2. Sven Sahlin, "Structural Masonry"- Prentice Hall Publisher: Prentice Hall, ISBN10: 0138539375, ISBN-13: 978-0138539375,1971.
3. Jagadish K S, "Sustainable Building Technologies", IK International Publishing House Pvt. Ltd., ISBN:978-93-86768-20-9, 2019

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/105/106/105106197/

Skill Development Activities Suggested

- Group based studies and Site visits

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level

CO1	Understand masonry materials and its mechanical properties	L1, L2, L3
CO2	Analyse the behaviour of structural masonry	L2, L3, L4
CO3	Demonstrate testing, analysis and design methodologies	L2, L3, L4, L5
C04	Summarize construction practices, specifications and inspection of masonry buildings	L2, L3, L4, L5

Mapping of COS and POs

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	x							
CO2		x	x	x				
CO3			x			x		
CO4			x		x	x		

Semester- 2

CONSTRUCTION EQUIPMENT & SAFETY MANAGEMENT			
Course Code	**22CIM245**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hr. Theory + 26 Hr. SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
This course will enable students to
- Understand the importance of safety in constructionindustry.
- Understand different types of equipment used in construction and its economicconsideration.

Module-1

Plants and Equipment for production of materials: Crushers, mixers, Bituminous mixing plants, concrete mixing plants, advantages, choice

Teaching-Learning Process	Black Board, Slides on Projector, Listing of Equipment Manufacturers

Module-2

Construction Equipment: Operations, applications and performance of Dozers, Excavators- Power Shovels, Back Hoe, Back Hoe Loader, Graders, compactors, Pavers for Flexible and Rigid Pavement, Crawler, wheel tractors and its attachments, Cranes, Hauling Equipment's.

Teaching-Learning Process	Black Board, Slides on Projector, Comparing Different Equipment Manufacturers, performance and its uses
Module-3	
Selection of Construction Equipment: Task considerations, Cost considerations, Engineering considerations, Equipment Acquisition options, Maintenance of Equipment: Repairs, log maintenance, safety during operation, Economical life of equipment.	
Teaching-Learning Process	Black Board, Slides on Projector, Field Examples
Module-4	
Safety in Use of Construction equipment's: Human Factors in Construction Safety management Motivation: Management, Supervisors, Workers, Motivational schemes, Role of first line supervisors, Role of middle managers, Roleofworkers,topmanagementpractices,SafetyprecautionsinExcavation,HeavyEquipment'sandinMulti-storey buildings. Life savingEquipment's	
Teaching-Learning Process	Black Board, Slides on Projector, Site Case Studies
Module-5	
Safety Management: Safety audit, Safety in site preparation, Design, safety culture, Top Management, Company Activities and Safety – Safety Personnel, Sub-contractual Obligation - Project Coordination and Safety Procedures, Fire causes, prevention and other Common hazards	
Teaching-Learning Process	Black Board, Slides on Projector, Site Case Studies

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

3. Three Unit Tests each of **20 Marks**
4. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Books

- Peurifoy, R.L., Ledbette. W.B., Construction Planning, Equipment and Methods, McGraw HillCo.
- Antil J.M., Civil Engineering Construction, McGraw Hill BookCo.
- SC Sharma, 'Construction equipment and its Management', KhannaPublications.
- Hand Book on Construction Safety Practices, SP 70, BIS2001.
- Jimmy W. Hinze, Construction Safety, Prentice Hall Inc.,1997
- Richard J. Coble, Jimmie Hinze and Theo C. Haupt, Construction Safety andHealth.

Web links and Video Lectures (e-Resources):

1. NPTELLectureSeriesConstructionMethodsandEquipmentManagement,CoordinatedbyIITGuwhati. https://archive.nptel.ac.in/courses/105/103/105103206/

Skill Development Activities Suggested

- ComparingdifferentmanufacturersConstructionEquipment-itsperformance,maximumabilityandcost consideration

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Identify and understand use of equipment and its benefits.	L1, L2
CO2	Selection of Equipment's and its application.	L1, L2, L3, L4, L5
CO3	Understand necessity of safety management.	L1, L2, L3,L4,L5
CO4	Identify importance, need of safety with respect to Client, contractor and subcontractors and site workers.	L1, L2, L3, L4, L5
CO5	Safety Implementation at Sites	L2, L3, L4, L5

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X	X						
CO2			X					
CO3			X		X			
CO4			X	X	X			
CO5		X				X		X

Semester- 2

CIM LABORATORY - 2			
Course Code	**22CIML26**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:2:0	SEE Marks	50
Credits	02	Exam Hours	03

Course objectives:
This course will enable students to
- Make students to learn principles of laboratoryexperiments.
- Understand the importance of laboratory testing ofmaterials.

Sl.NO	Experiments
1	Mix Proportion of Concrete (using partial replacement of fly-ash or GGBS) as per IS -10262-2019.
2	Self-Compacting Concrete – Fresh and hardened properties- as per IS - 10262-2019
3	High Strength Concrete – Fresh and hardened properties - as per IS - 10262-2019.
4	Mass Concrete – Fresh and hardened properties - as per IS - 10262- 2019.
5	CLSM - Fresh and hardened properties
6	Permeability tests on hardened concrete – Demonstration
7	Test on Bituminous materials – Flash and fire, Ductility test, Penetration test; Softening point test, Specific gravity test and Viscosity test.

Course outcomes (Course Skill Set):

At the end of the course the student will be ableto:

After studying this course, students will be ableto:

- Determine the mix proportion of normal concrete and effect of filler on fresh and Hardened Properties through experiments.
- Development of Special concrete mixes like SCC, HSC and MassConcrete.
- Determine the Fresh and hardened properties of special concrete mixes like SCC, HSC, and MassConcrete.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adheredtoby theexaminers.**OR**basedonthecourserequirementevaluationrubrics shallbedecidedjointlyby examiners.

Studentscanpickonequestion(experiment)fromthequestionslotpreparedbytheinternal/externalexaminers jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Suggested Learning Resources:

- https://onlinecourses.nptel.ac.in/noc22_ce09/preview
- https://nptel.ac.in/courses/105104206

Semester- 3

Maintenance and Rehabilitation of Structures			
Course Code	**22CIM31**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	39 Hr. Theory + 26 Hr. SDA	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives:

This course will enable students to
- Learning the structural properties for causingfailures
- Identification of failure phenomenon; New approach in the designaspects
- Understanding the concept of serviceability anddurability

Module-1

Durability and Deterioration:
Introduction, Durability of concrete, Causes of distress in concrete structures, Chemical attack on the concrete – Sulphate attack, Chloride attack, Carbonation attack, Alkali Aggregate Reaction. Corrosion of steel reinforcement: Factors influencing corrosion, mechanism, corrosion protection.

Teaching-Learning Process	Black board and POWER POINT PRESENTATIONS

Module-2

Damage Assessment:
Introduction, Purpose of assessment, Investigation of damage, Observation, Damage assessment procedure.
Destructive Testing system- Testing system of hardened concrete, Direct Load tests.
Non-Destructive Testing – Rebound Hammer, Ultrasonic Pulse Velocity.
Semi-Destructive Testing: Probe Test, Pull-Out Test, Pull-Off Test, Break-Off Test, Core Test, Half-Cell Potential Measurements, Resistivity Measurements, Carbonation Depth Testing, Tests for determining cement content, chloride content and sulphate content.

Teaching-Learning Process	Black board and POWER POINT PRESENTATIONS

Module-3

Repair Materials:
Selection of Repair Materials, Classification of repair materials, Grouts, Resin based materials, Sealing materials, Sealant types and properties, Water proofing materials, Bonding materials, Polymer resin-based materials, Cement based coatings, Bituminous materials, SIFCON and SIMCON materials, Carbon wrapping.

Teaching-Learning Process	Black board and POWER POINT PRESENTATIONS

Module-4

Repair of Cracks:
Introduction, Factors effect cracking, Measure of cracking, Stages of concrete repair, Types and classification of repair, Methods of Repair- Resin injection, Routing and sealing, Stitching, Dry packing, External stressing, Bonding, Polymer impregnation, Vacuum impregnation.
Rehabilitation Techniques
Introduction, Replacement mortar, Resin Injection, Dry packing, Sprayed Concrete, Grouting, Slab Jacketing, Tremie concrete. Epoxy bonded dry pack.

Teaching-Learning Process	Black board and POWER POINT PRESENTATIONS
Module-5	
Strengthening Techniques Introduction, Need for Strengthening, Structural concrete repair, Structural repair technique for R C structure, Jacketing technique, External Post-tensioning, externally bonding technique, Externally bonded mild steel plates, Strengthening by SIMCON, Section enlargement.	
Teaching-Learning Process	Black board and POWER POINT PRESENTATIONS

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Books:

1. B.Vidivelli,"RehabilitationofConcreteStructures",1e,StandardPublishers,ISBN:978-8180141102,2009.

References:

1. TedKay,"AssessmentandRenovationofConcreteStructures",1e,LongmanScientific&Technical,ISBN:978-0582057791,1992.
2. R. T. L. AIlen and S. C. Edwards, "Repair of Concrete Structures", 1e, Blackie & Son, ISBN: 978-0751400861, 1993.
3. Sidney M. Johnson, "Deterioration, Maintenance and Repair of Concrete Structures", McGraw- HillBook
4. P. H. Perkins, "Repair, Protection and Water proofing of Concrete Structures", 3e, CRC Press, ISBN: 978-0419202806,1997.
5. R. N. Raikar, "Diagnosis and Treatment of Structures in Distress", Structwel D & C Pvt. Ltd,1994
6. Ransem W. H, "Building Failures", E & F.N, SPON Ltd,1981.
7. RalphHaas,RonaldHudsonandZaneiswki,"ModernPavementManagement",KreigerPublications,ISBN:978-0894645884,1994.
8. Peter H. Emmons, "Concrete Repair and Maintenance", John Wiley & Sons, ISBN: 978-0876292860,2002.
9. S. Champion, "Failure and Repair of Concrete Structures", John Wiley & Sons, 1961.
10.Handbook on Concrete Durability, Indian Concrete Institute, Chennai,2019.
11. Peter H. Emmons, Brandon W. Emmons (Illustrator), Concrete Repair and Maintenance Illustrated: Problem Analysis; Repair Strategy; Techniques, ISBN: 978-0876292860,1992.
12. Concrete Repair manual (2nd Edition). International Concrete Repair Institute,2007.
13. ACIpublications

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/105105213

Skill Development Activities Suggested

- Exposure to latest repair materials available from variousmanufacturers
- Case studies via sitevisits
- Review articles / reports on advanced materials available in the market, and its possibleapplication

COURSE OUTCOMES:

At the end of the course the student will be able to:

Sl. No.	DESCRIPTION	BOs
1	Understand the mechanisms of degradation of concrete structures and design durable concrete structures.	L1, L2, L3
2	Learn how to conduct field monitoring and non-destructive evaluation of concrete structures.	L3, L4, L5
3	Formulate a strategy for repair and rehabilitation by selecting appropriate repair materials and techniques.	L2, L3, L4

Mapping of COs and POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X			X		X		X
CO2	X		X		X	X	X	
CO3		X		X		X		X

Semester- 3

CONSTRUCTION QUALITY AND MATERIAL MANAGEMENT			
Course Code	**22CIM321**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	39 Hr. Theory	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This Course will enable the students to

- Understand the various types of Quality Management, uses, effect and itsimportance
- Understand the effect of material management for projectorganization

Module-1	
Evolution of quality management, Importance of Quality, Quality tree, Benefits of quality, Types of quality, customer driven definitions of quality, quality in production system	
Teaching-Learning Process	ISO Documents
Module-2	

Cost of quality, quality control: objectives of qc, inspection, quality at source, Quality control strategy and policy, Quality Assurance, Quality assurance system, principles of total quality control	
Teaching-Learning Process	Case Studies
Module-3	
Meaning, definition, uses and Drawbacks; Total Quality management, ISO Certification, SIX Sigma, Quality Circles, Causes and Effect Diagram	
Teaching-Learning Process	Case Studies
Module-4	
Material Management: importance, Integrated material Management, classification of Material, ABC analysis, standardization, purchase management, codification types and its uses, Price forecasting benefits and its methods: Average method, moving average method, weighted Average method, exponential smoothening.	
Teaching-Learning Process	Examples of Markets Prices
Module-5	
Inventory Management, Store Accounting: LIFO, FIFO, Average cost and market cost, relevant cost of inventory.	
Teaching-Learning Process	Comparison of each method of accounting for the same product and reviewing store accounts

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. TheSEEquestionpaperwill besetfor100marksandthemarksscoredwillbeproportionatelyreducedto 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Eachfullquestionisfor20marks.Therewillbetwofullquestions(withamaximumoffoursub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Books

1. K. Sridhara Bhat, Total Quality Management, Himalaya Publishing House,2014.
2. Bester Field, "Total Quality Management", by PearsonEducation.
3. Juran Frank, J.M. and Gryna, F.M, Quality Planning and Analysis, Tata McGraw Hill,1982.
4. Hutchins. G, ISO 9000, Viva Books, New Delhi,1993.
5. Datta, Material Management Procedures, Text and Cases, 2e PrenticeHall
6. Gopalakrishnan, P, Sundaresan, "Material Management - an Integrated Approach", PrenticeHall

Web links and Video Lectures (e-Resources):

1. NPTEL Lecture Series Quality Management, coordinated by IIT Bombay. https://archive.nptel.ac.in/courses/110/101/110101010/

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Importance of Quality Management	L1, L2
CO2	Different tools, certification, and control methods	L3, L4
CO3	Importance of material management, procurement, uses and control methods	L1, L2, L3

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1				x	x			
CO2	x			x	x			
CO3				x	x			

Semester- 3

INFRASTRUCTURE CONSTRUCTION METHODS			
Course Code	**22CIM322**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	39 Hr. Theory	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to

- Understand types and methods of construction of RCstructures.
- Understand types and methods of long span structuresconstruction.
- Understand types and methods of construction of Undergroundstructures

Module-1

Formwork and High-Rise RC Structures Construction:

General, formwork - Beams, Slabs (normal and flat slabs), Columns, Foundations (shallow), Shear Walls, Calculation of Horizontal Formwork Pressure as per ACI. Erection techniques of High-Rise Building - Slip form - Jump form – Climb form – Table form.

SDA: Field visit to nearer high-rise building construction.

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS and Skill enhancement through SDA

Module-2

Segmental and Cantilever Construction:

General Construction of RC and PSC Bridges; Types of superstructure construction - Deck Slab, T-beam, and Box girder deck; Erection of Segments – Form travelers and Launching girders. Construction of Segmental Bridges – BalanceCantileverMethod,SpanbySpanmethod,IncrementalLaunchingMethod,Progressiveplacementmethod.

SDA: Field visit to BMRCL metro works

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS and Skill enhancement through SDA

Module-3

Composite Construction:

Composite Construction – General, Terminology, Advantages, Applications; Construction of Composite Floor Systems; Construction of Composite Beams Systems; Construction of Composite Columns (fundamentals). Construction of Steel Frame Structures – Construction procedure only.

SDA: Group activity - Geo-synthetics material for different structural applications.

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS and Skill enhancement through SDA

Module-4

Tunnel Construction:

Tunnel Construction and methodologies: General, Types of Tunnels, Tunnel Constructions – Open cut method, Cut and Cover method, Tunnel Boring method (TBM), New Austrian Tunnelling Method (NATM). Repair of Tunnels: Short Term Repairs, Long Term Repair, Reconstruction and New Construction.

SDA: Field visit to BMRCL metro works

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS and Skill enhancement through SDA

Module-5

Special Structure Construction:

Top and down construction Methods: General construction sequence for Building tower constructions. Transmission Towers: General Construction procedure of transmission towers. Demolition and Dismantling of Buildings - Building Demolition Process.

SDA: Group activity - Understanding demolition equipment and techniques.

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS and Skill enhancement through SDA

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Textbooks:

1. Austin, C.K., Formwork for Concrete, Cleaver -Hume Press Ltd., London,1996.
2. Hurd, M.K., Formwork for Concrete, Special Publication No.4, American Concrete Institute, Detroit,1996.

References:

1. Jaafar Mohammed, "Engineering Geology & Tunnels Engineering", 2015. 2. Raina V. K. "Concrete Bridge practice", Tata McGraw Hill Publishing Co.
3. Chew Yit Lin, Michael, "Construction Technology for Tall Buildings", Singapore University Press, World Scientific, Hong Kong,
4. Ponnuswamy. S, "Bridge Engineering", Tata McGraw Hill.
5. Roy Chudley and Roger Geeno, "Advanced Construction Technology", Latest Edition,2005.
6. Sankar S. K. And Saraswati. S, "Construction Technology", Oxford University Press, New Delhi,2008.
7. Gahlot. P. S and Sanjay Sharma, "Building repair and maintenance management", CBS Publications,2006.
8. Relevant IRCCodes

Web links and Video Lectures (e-Resources):

https://onlinecourses.nptel.ac.in/noc21_mg81/preview

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	They can able to design the formwork for beam, column, slab elements	L3
CO2	They can get the basic idea of various types of construction techniques adopted in Bridge constructions.	L3, L4, L5
CO3	They are able to address the special problems in underground constructions.	L4, L5
CO4	They will understand the basic constructional methods for bridge segmental, composite constructions and special construction methods like top and bottom constructions.	L3, L4

Mapping of COs and POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X			X				
CO2	X				X	X	X	X
CO3	X	X	X				X	
CO4	X	X	X				X	X

DISASTER MITIGATION AND MANAGEMENT			
Course Code	**22CIM323**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	39 Hr. Theory	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to

- Understand some of the basic terminologies related to disasters andvulnerabilities.
- Explain different types of disasters and theirmagnitudes.
- Understand the role played by GIS in disaster planning andpreparedness.
- Elaborate on disaster response policies andmethods.
- Understand and explain disaster recovery and mitigation usingGIS

Module-1

Disaster terminology, threat, danger, natural and manmade disasters, crisis, calamity, catastrophe, Cataclysm, hazard vulnerability and risk, types of vulnerability, disaster mitigation and management.

Teaching-Learning Process	Black board/PowerPoint presentation

Module-2

Typesofdisasters,volcanoes,earthquakes,Tsunami,landslides,lightningandthunderstorms,cyclones,Hurricanes andTyphoons,floods,draughtandFamine,Firedisasters,theirmagnitudesandextentofdamagestheycancause.

Teaching-Learning Process	Black board/PowerPoint presentation
Module-3	
Geographic Information Systems and Disaster Planning and Preparedness, Introduction, Technology and Dataset Planning and Preparation, Essential Disaster Management Map Layers, Additional Sources of Ideas for Essential DisasterManagementMapLayers,DepartmentofHomelandSecurityGeospatialDataModel,TechnologyPlanning and Preparation, Organizational Perspectives, Using GIS to Support Planning and Preparation Activities , Spatial Perspectives on Broader Planning and Preparation Activities, Common GIS Tasks for Disaster Planning and PreparationActivities,EvacuationRoutePlanning,EvacuationZonePlanningScenarioModellingtoAnswerWhat- If Questions , Public Outreach and CitizenParticipation.	
Teaching-Learning Process	Black board/PowerPoint presentation
Module-4	
Geographic Information Systems and Disaster Response, Introduction , Disaster Response Policy in the United States ,GeographicalAspectsofSituationAwareness,MapsandEmergencyOperationCenters,GISandDisasterWarnings, Spatial Data Deluge , Thematic Maps, Spatial Statistics, Hot Spot Mapping, Density Mapping, Real-Time GIS, Disaster ResponseGISProducts,OnlineDisasterResponseGeographicDataStreams,GISandDamageAssessment,FieldData Collection and Mobile GIS, Public and Disaster Response Mapping—Crisis Mapping and CitizenReporting.	
Teaching-Learning Process	Black board/PowerPoint presentation
Module-5	

Geographical Aspects of Disaster Recovery, Using GIS to Support Disaster Recovery Tasks , Geo collaboration, Restoring Critical Infrastructure, Debris Cleanup , Recovery Planning, Transition from Recovery to Mitigation, Vulnerability,, Resilience, Disaster Mitigation Policy and International Perspectives on GIS , International PerspectivesonDisasterMitigation:UNISDR,GISTechniquesforDisasterMitigation,SpatialIndexingandModeling of Risk and Vulnerability , Social Variables , Physical Variables, Using GIS to Develop Spatial Indexes of Vulnerability andRisk.	
Teaching-Learning Process	Black board/PowerPoint presentation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Books:

1. RajendraKumarBhandari,DisasterEducationandManagement:AJoyRideforStudents,teachersand Disaster managers, Springer India,2014.
2. Brian Tomaszewski, Geographic Information Systems (GIS) for Disaster Management, CRC Press – Taylor and Francis,2015.

References:

1. Ramesh R. Rao, Jon Eisenberg, and Ted Schmitt, Improving Disaster Management: The Role of IT in Mitigation, Preparedness, Response, and Recovery, National Academic Press, Washington DC,2007.
2. G. Kishore Babu, Bhabani Dikshit, Stuti S. Mandala, Disaster Management & Mitigation, World Focus,2016.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/105104183

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Differentiate between several forms of disasters and also to assess vulnerabilities and to suggest possible management and mitigation methods.	L2, L3, L4

CO2	Demonstrate and decipher the knowledge about kinds of disasters like earthquake, Tsunami, Hurricanes, Typhoons and fire disasters and to explain the possible magnitudes of disasters	L1, L2, L3
CO3	Understand how international disaster management operates and the various organizations and mechanisms involved in international disaster management. Understand the importance of scenario modelling for training purposes in the use of GIS to help answer what-if questions for disaster planning	L3, L4, L5
CO4	Discern the difference between different disaster management terms, understand different disaster management cycle components, understand the role of Geographic Information Systems (GIS) within different disaster management policies and jurisdictional levels	L2, L3, L4
CO5	Identify specific GIS techniques that can be used to support disaster recovery, recovery planning processes that involve community members, and discern the overlaps between disaster recovery and disaster mitigation and how GIS and corresponding spatial data can serve both disaster recovery and mitigation needs.	L2, L3

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1				X				
CO2				X				
CO3				X				
CO4				X				
CO5				X				

Semester- 3

Transportation Planning			
Course Code	**22CIM324/22CHT324**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hr. Theory	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to

- Understand the different modes of transportation and factors affecting planning process for an effective transportationsystem.
- Understandthecharacteristicsofmasstransitsystemandmethodsofcollectingtrafficdatatoproposean effective transportfacility.
- Understand and sources of zonal trip generation or attraction and then interzonal trip distributionmethods.
- Analysethemodeoftransportanditsimpactontransportsystemandalsothemethodsofassigningtraveltrips to various routes for effectivemanagement.
- Understand the mass transportation options and evaluation of the systems for economicsustainability.

Module-1

UrbanizationProcess:Urbangrowthmechanism–Urbanmorphology-Urbanisation&traveldemand-Urban development planning policy – NUTP - Urban transport projects - Urban transport problems in India.Urban

Transport Planning Process: Urban travel patterns - Study area delineation Zoning - Planning surveys - Urban activity system- Sustainable urban transport - Systems approach.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving
Module-2	
Travel Demand Estimate: Trip based and activity-based approach - Four stage travel demand modeling - Data needs and outputs - Quick response techniques - Survey designs. Trip Generation: Productions & Attractions - Influential factors –Trip rate analysis, Category analysis- Simple & Multiple linear regression models – FHWA method.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving.
Module-3	
Trip Distribution: Interchange matrix – Growth factor methods – Synthetic methods calibration of Gravity model. Modal Split: Influential factors – FHWA Procedure – Diversion curves & surfaces Discrete choice models, Concept, Types, BL, MNL & HL mod	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving
Module-4	

TripAssignment:TripAssignmentprocedure–Diversioncurves-BPRmodel-AllorNothingassignment-Multipath assignment - Capacity restraint assignment – User equilibrium and system equilibrium approach - Stochastic assignmentapproach.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving
Module-5	
Land Use Transport System: Urban system components - Urban spatial structure Accessibility - Location theory - Land use models - Land use transport models, Lowry & Garin – Lowry models. Urban public transportation: Urban growth and public transport needs - Transit mode classifications – Transit characteristics - Fleet size and capacity estimation. Use of softwares: TransCAD, CUBE.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS, Skill enhancement through problem solving, software learning

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. TheSEEquestionpaperwill besetfor100marksandthemarksscoredwillbeproportionatelyreducedto 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Eachfullquestionisfor20marks.Therewillbetwofullquestions(withamaximumoffoursub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Books:

1. Hutchinson, B.G., "Principles of Urban Transport System Planning"– McGraw Hill BookCo.
2. L.R. Kadiyali, "Traffic Engineering and Transportation Planning"– KhannaPublication.
3. Khisty C J., Lall B.Kent, Transportation Engineering – An Introduction, Prentice-Hall, NJ,2005
4. Ortuzar, J. D., Willumsen, L.G., Modeling Transport, John Wiley & Sons,1994
5. Papacostas C.S. and Prevedouros, P.D., Transportation Engineering & Planning, PHI, NewDelhi,2002
6. Chakroborty P., Das N., Principles of Transportation Engineering, PHI,NewDelhi,2003
7. Dickey J.W., Metropolitan Transportation Planning, Tata Mc-Graw Hill1980

Reference Books:

1. Nicholas J.Garber, Lester A. Hoel, "Traffic and Highway Engineering", Third Edition ThompsonLearning
2. Institute of Traffic Engineers – "An Introduction to highway Transportation Engineering", ITE,USA
3. Bowmen, J. and M. ben-Akiva, Activity based travel Forecasting; in Activity based travel forecasting. Washington, DC: U.S. Department of Transportation, ReportDOT-97-17.
4. Bruton M.J., Introduction to Transportation Planning, Hutchinson of London,1988

Web links and Video Lectures (e-Resources):

- .https://archive.nptel.ac.in/courses/105/105/105105208/
  - https://archive.nptel.ac.in/courses/105/107/105107067/

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Learn about several forms of transportation and the elements that influence the planning process for each mode.	L1, L2, L4, L5
CO2	Propose effective transport facility for the mass transportation after collecting the data required.	L1, L2, L3, L4, L5, L6
CO3	Calculate the distributions of trips as well as the inter-zonal trip generations or attractions.	L2, L3, L4, L5, L6
CO4	Analyse the influence of each form of transportation on the transportation system to better understand optimal route management.	L1, L2, L4, L6
CO5	Evaluate the economic sustainability of the mass transportation systems.	L1, L2, L6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X	X	X	X	X	X	-	X	X
CO2	X	X	-	-	X	X	-	X	X
CO3	X	X	X	X	X	X	-	X	X
CO4	X	X	-	-	X	X	-	X	X
CO5	X	X	X	X	X	X	-	-	X

Semester- 3

FOUNDATION TECHNOLOGY			
Course Code	**22CIM325**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	39 Hr. Theory	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to

- To learn about types and purposes of different foundation systems andstructures.
- To provide students with exposure to the systematic methods for designingfoundations.
- To discuss and evaluate the feasibility of foundation solutions to different types of soil conditions considering the time effect on soilbehavior.
- To build the necessary theoretical background for design and construction of foundationsystems.

Module-1

Bearing Capacity

Definition and terms used related to bearing capacity, Bearing capacity theories and empirical methods - Terzaghi's Method, Skempton's analysis for clays, Mayerhof's analysis, BIS Method (IS: 6403) – (Excluding Numerical Problems) Effects of water table fluctuation and eccentric foundation base in calculating ultimate bearingcapacity;TestprocedureforddeterminationofBearingCapacityfromfieldtests-PlateLoadTest,Standard PenetrationTest,ConePenetrationTest:advantagesandlimitations(excludingnumericalproblems);Factors influencing Bearing Capacity.

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS and Skill enhancement through SDA

Module-2	
Shallow Foundations General types of Foundation – Classification and Types; Construction Aspects; Choice of foundation type and Preliminary Selection; Design features and construction details related to size and depth of footing; (numerical problems excluded) Raft Foundations: Common types of Raft foundations; General considerations in design of rafts;constructionaspectsofraft;(numericalproblemsexcluded)Coefficientofsub-gradereaction–importance,	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS and Skill enhancement through SDA
Module-3	
Deep Foundations Types of deep foundations – Piles, Piers and Cassions; Piles: Classification of piles – Based on Function – End Bearing, Friction, Tension, Compaction, anchor, fender, sheet, batter, laterally loaded pile etc.; Based on Composition and material – timber, steel, Concrete; Based on Method of installation – Driven, cast-in-situ, driven and cast in- situ - Brief details, advantages and disadvantages; Installation of Pile: Equipment for installation of piles by driving and boring, cast in situ place method.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS and Skill enhancement through SDA
Module-4	
Deep Foundations PileCapacity:Loadtransfermechanism(onlyconcept);Methodsofdeterminingultimateloadbearingcapacity(only methods; no theoretical aspect / problems); Piles in group – concept of pressure isobars and typical arrangement only;Conceptofnegativeskinfrictionandupliftcapacityofpiles(onlyconcept);DrilledPiers:Types-Straight-shaft	

end-bearing piers, Straight-shaft side wall friction piers, Combination of straight shaft side wall friction, Belled or under reamed piers; Advantages and disadvantages; Methods of Construction – The dry casing and slurry methods. Cassions:Introduction,Types–Open,Pneumatic&FloatingCassions–Components,Advantages,anddisadvantages.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS and Skill enhancement through SDA
Module-5	
Soil Stability: Retaining walls: Introduction, Types of earth retaining structures, Modes of failure of retaining walls, drainage of backfill, Types of earth pressure – Active, passive, earth pressure at rest (only concept, no earth pressure theories); Stabilityconsiderationsforretainingwalls;(numericalproblemsexcluded)BracedandUnbracedExcavations;Sheet Piles: Introduction, Sheet Pile Structures – Cantilever, anchored, braced sheeting, single cell cofferdams, cellular cofferdams; (only types, numerical problems excluded) Shoring and Underpinning: Necessity andMethods.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS and Skill enhancement through SDA

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. TheSEEquestionpaperwill besetfor100marksandthemarksscoredwillbeproportionatelyreducedto 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Eachfullquestionisfor20marks.Therewillbetwofullquestions(withamaximumoffoursub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Book:

1. V N S Murthy, "Geotechnical Engineering – Principles and Practices of Soil Mechanics and Foundation Engineering", Marcel Dekker Inc., New York, ISBN: 0824708733,2003

2. C. Venkatramaiah, "Geotechnical Engineering", 5e, New Age International (P) Ltd., ISBN: 978-9386070135, 2017.

References:

1. Tomlinson M J, "Foundation Design and Construction", 7e, Pearson Education, ISBN: 978-0130311801, 2001.

2. Bowles Joseph E, “Foundation Analysis and Design”, 5e, McGraw Hill, ISBN: 978-0071188449,2001.
3. Braja M. Das, “Principles of Foundation Engineering”, 7e, Cengage Learning (SI Unit Edition), ISBN: 978-0495668121,2007.
4. B C Punmia, “Soil Mechanics and Foundations”, 16e, Laxmi Publications (P) Ltd., ISBN: 978-8170087915, 2017.
5. IS6403:1981(Reaffirmed2002)DeterminationofbearingcapacityofShallowfoundations,BureauofIndian Standards, NewDelhi.
6. IS 8009:1980 – Part I & II Calculation of Settlement of Foundation, Bureau of Indian Standards, NewDelhi.
7. Tomlinson M J, “Pile Design and Construction Practice”, 5e, Taylor & Francis, ISBN: 978-0415385824,2008.

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/105105176
2. https://nptel.ac.in/courses/105101083

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	An ability to identify & design various types of foundations according to field conditions.	L2, L3, L4
CO2	To build the knowledge on soil behaviour and introduce to design issues pertaining to different types of foundations.	L4, L5

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X	X		X	X	X	X	
CO2	X		X	X	X	X	X	X

02-11-2022/V4

Semester- III

Smart Civil Infrastructure			
Course Code	**22CIM331**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3

Course Learning objectives:

- To understand the need for smart infrastructure
- To deliberate on applications of various smart materials used in building smart infrastructure.
- To understand the role of bio-inspired material, fibre optic sensors and self-healing materials.
- To explain various sensory systems such as wind, pressure, seismic and level sensors and their utility.
- To describe various non-destructive testing methods, self-healing materials, and self-repairing concrete.

Module-1 **7 Hours**

troduction to civil structures, loading conditions and environment, materials used in civil structures, design construction and maintenance, necessity for smart structures, definition of smart civil structures, historical development of smart civil structures. : 7 Hours

Module-2 **8 Hours**

Smart materials, shape memory alloys, basic characteristics of shape memory alloys, constitutive modelling of shape memory effect, applications of shape memory alloys in smart civil engineering structures, piezoelectric materials, applications of piezoelectric materials in smart civil structures. magnetostrictive materials, basic characteristics, applications in smart civil structures.

Module-3 **8 Hours**

ectro-rheological and magneto-rheological materials, characteristics, their applications in smart civil structures, optical fibres, characteristics of optical fibres, fibre-optic sensors and their applications in smart civil structures. Bio inspired materials, bio inspired materials for sensing systems, self-healing materials, nano materials.
Module-4 8 Hours
Sensors and sensory systems, wind sensors, pressure transducers, wind profile measurements, seismic sensors, load cells, weigh in motion, thermometers, strain gauges, displacement sensors, level sensors, tilt beams, Global navigation satellite system, accelerometers, fibre optic sensors, non-contact sensors, weather stations, chemical and corrosion sensors
Module-5 9 Hours
uctural damage detection, non-destructive testing methods, Ultrasonic pulse velocity method, Impact-echo/impulse-response methods, acoustic emission method, radiographic method, eddy current method, infrared thermographic method, concept of structural self-rehabilitation, self-healing materials, and self-repairing concrete.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum mark. The minimum passing mark for SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. You lin Xu, Jia He, Smart Civil Structures, Taylor & Francis Publications, 2017..
2. Macro Casini, Smart Buildings Advanced Materials and Nanotechnology to Improve Energy-Efficiency and Environmental Performance, Wood Head Publishing, 2016.
3. Caijun Shi, Y.N.Mo, High performance construction materials – science and applications, World scientific publishing, 2008.
4. Joseph N. Pelton , Indu B. Singh, Smart cities of today and tomorrow- Better technology and Infrastructure, Springer International Publishing, 2019.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=FOzBe0ePw68.
- https://www.youtube.com/watch?v=6Us25DGQk8c.

Skill Development Activities Suggested

- Student seminars on related topics that is beyond syllabus.
- Discussion with experts and listening to expert lectures.
- Field visits and making reports on the learnings.

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :

Sl. No.	Description	Blooms Level
CO 1	Elaborate on smart structures concepts and the necessity of smart structures and smart materials	L2
CO 2	Present the applications of shape memory alloys, piezoelectric materials, and magneto strictive materials in developing smart civil infrastructure.	L2 & L3
CO 3	Use the knowledge gained to select appropriate smart materials from among host of available ones.	L3
CO 4	Apply the knowledge about sensors to select appropriate sensor to address the situation or the need.	L2
CO 5	Deliberate on non-destructive methods and be able to recommend appropriate technique from among host of techniques specific to the nature of structure and nature of distress.	L2

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X							
CO2	X		X					
CO3	X		X					
CO4	X	X						
CO5	X		X					

Construction Quality and Material Management			
Course Code	**22CIM332**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	

Course Learning objectives:

- To understand the various types Quality Management, uses, effect and its importance
- To understand the effect of material management for project organization
- To explain the concepts of total quality management
- To elaborate on material management techniques
- To delve on inventory management

Module-1

volution of quality management, importance of quality, quality tree, benefits of quality, types of quality, customer driven definitions of quality, quality in production system

Module-2

Cost of quality, quality control: objectives of qc, inspection, quality at source, Quality control strategy and policy, Quality Assurance, Quality assurance system, principles of total quality control

Module-3

eaning, definition, uses and Drawbacks; Total Quality management, ISO Certification, SIX Sigma, Quality Circles, Causes and Effect Diagram

Module-4

Material Management: importance, Integrated material Management, classification of Material, ABC analysis, standardization, purchase management, codification types and its uses, Price forecasting benefits and its methods: Average method, moving average method, weighted Average method, exponential smoothening.
Module-5
ventory Management, Store Accounting: LIFO, FIFO, Average cost and market cost, relevant cost of inventory.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum mark. The minimum passing mark for SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. K. Sridhara Bhat, Total Quality Management, Himalaya Publishing House, 2014.
2. Bester Field, "Total Quality Management", by Pearson Education.
3. Juran Frank, J.M. and Gryna, F.M, Quality Planning and Analysis, Tata McGraw Hill, 1982.
4. Hutchins. G, ISO 9000, Viva Books, New Delhi, 1993.
5. Datta, Material Management Procedures, Text and Cases, 2e Prentice Hall
6. Gopalakrishnan , P, Sundaresan, "Material Management - an Integrated Approach", Prentice Hall.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=_HRdjDid8bI.
- https://www.youtube.com/watch?v=ypTiYyh7YT0.
- https://www.youtube.com/watch?v=PBqxh6NnhUE.
- https://www.youtube.com/watch?v=L76lvCxdf4s.

Skill Development Activities Suggested

- Presenting seminars on related topic beyond the syllabus.
- Doing small projects related to the subject using project management tools such as M.S.Projects.

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :

Sl. No.	Description	Blooms Level
CO 1	Elaborate on importance of construction quality management, and be able to implement the same in real world situation.	L2 & L3
CO 2	Use different computational tools, and be able to recommend certification and suggest control methods	L2 & L3
CO 3	Apply material management, and procurement schemes and be able to implement different control methods	L3& L4
CO 4	Apply integrated material management techniques and be able to perform ABC analysis and standardization.	L3 &L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	X		X							
CO2	X		X							
CO3	X		X							

Semester- 3

Sustainable Materials and Constructions			
Course Code	**22CIM333/22CHT333**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	39 Hr. Theory	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to
- Demonstrate competent knowledge of Sustainability, their potentials, their relation, pros andcons;
- Identify specific actions that can be taken to conserve energy and to promote the development and use of renewableenergy

Module-1

Overview of Civil Engineering Material - Material properties, Sustainable Construction Materials - Marginal materials, recycled materials, design aspects, construction practices using non-conventional materials and methods,millingandrecyclingtechniques.Componentsofamaterialspecification•Sustainability-basedmaterial specifications

Teaching-Learning Process	Black board and POWER POINT PRESENTATIONS

Module-2

Energy Savings in Construction - Fundamentals of energy - Energy production systems, Energy and resource conservation, Energy efficient design strategies, Renewable energy sources – advantages and disadvantages; Energy management and conservation: electrical equipment - Improvement of power factor -maximum energy demand.	
Teaching-Learning Process	Black board and POWER POINT PRESENTATIONS
Module-3	
Sustainable Civil Engineering Design Practice - ASCE Policy on the Role of the Engineer in Sustainability Other guidelines for sustainable design; Sustainability metrics for materials, Green building rating system: Introduction to IGBC and LEED rating systems – various criteria for building rating	
Teaching-Learning Process	Black board and POWER POINT PRESENTATIONS
Module-4	
Life-Cycle Assessment (LCA) - Use of sustainability metrics in LCA, Selection of materials using LCA	
Teaching-Learning Process	Black board and POWER POINT PRESENTATIONS
Module-5	
Application of sustainability concepts in a real project - Design a Highway/ Infra structure projects by integrating sustainability concepts	
Teaching-Learning Process	Black board and POWER POINT PRESENTATIONS

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. TheSEEquestionpaperwill besetfor100marksandthemarksscoredwillbeproportionatelyreducedto 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Eachfullquestionisfor20marks.Therewillbetwofullquestions(withamaximumoffoursub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Books:

1. K S Jagadish, B V Venkataramana Reddy, K S Nanjunda Rao, "Alternative Buildings Materials and Technologies", 2e, New Age International Publishers, New Delhi, ISBN: 978-9385923876,2017

2. KSJagadish,"SustainableBuildingTechnologies",IKInternationalPublishersPvt.Ltd,NewDelhi,ISBN:978-9386768209,2019.

References:

1. Moore F: Environmental Control System McGraw Hill, Inc.,1994.

2. JMPQ Delgado, "Sustainable Materials in Building Construction", Volume 11, Building Pathology and Rehabilitation, Springer, ISBN 978-3-030-46799-9 ISBN 978-3-030-46800-2 (eBook),2020

3. Brown, G Z, Sun, Wind and Light: Architectural design strategies, John Wiley,1985

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/105105157
2. https://nptel.ac.in/courses/105102195

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Identify principles of sustainability and its role in construction sector	L2, L3
CO2	Compute the life cycle energy of a typical building	L4, L5
CO3	Develop recycling process for various types of marginal materials	L2, L5
CO4	Characterize marginal materials	L3, L4
CO5	Evaluate recycled products made from marginal materials	L2, L4
CO6	Assess sustainability through rating systems	L5

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X	X	X			X		
CO2	X	X		X	X	X		
CO3	X	X		X	X	X		
CO4	X	X		X		X		
CO5	X	X		X		X		
CO6	X	X	X		X		X	

Semester- 3

Application of AI in Engineering Infrastructure			
Course Code	**22CIM334/22CHT334**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	39 Hr. Theory	Total Marks	100
Credits	03	Exam Hours	03

Course objectives: The primary objective of this course is to introduce the basic principles, techniques, and applications of Artificial Intelligence specifically to post graduate students. Emphasis will be placed on the teaching of these fundamentals, not on providing a mastery of specific software tools or programming environment. Specific objectives are, to:

- Gain a historical perspective of AI and itsfoundations.
- Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, andlearning.
- InvestigateapplicationsofAItechniquesinartificialneuralnetworksandothermachinelearning models.
- Explore the current scope, potential, limitations, and implications of intelligentsystems.

Module-1

Introduction:

A brief history of AI, strong methods and weak methods, uses and limitations, AI in future, knowledge representation, the need for good representation, semantic nets, inheritance and frames. General applications of AI in civil engineering.

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS and Skill enhancement through SDA
Module-2	
Search methodologies, problem solving as search, data driven /goal driven search, depth first search, breadth firstsearch,problemsolvingassearch,propertiesofsuchmethods,whyhumansusedepthfirstsearch,illustrative examples(traversingaMaze,searchingforgift),informedanduninformedmethods ofsearching.Illustrativereal world problems of civil engineeringinterest.. Problems Related to construction management.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS and Skill enhancement through SDA
Module-3	
IntroductiontoMachineLearning,Conceptlearning,general-to-specificordering,versionspaces,inductivebias, general to specific ordering, version spaces, supervised learning, unsupervised learning, reinforcement learning. Illustrative real-world examples of machine learning of civil engineeringinterest. Problems Related to construction management.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS and Skill enhancement through SDA
Module-4	
ArtificialNeuralnetworks,introduction,neurons,perceptrons,thecapabilitiesofasingleperceptron,multilayer neural networks, capabilities of multilayer neural networks, back propagation, unsupervised learning networks, Kohonen maps. Illustrative real-world examples on applications of neural networks in highway/ infrastructure constructionmanagement. Problems Related to construction management.	

Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS and Skill enhancement through SDA
Module-5	
Learning under uncertainty and ambiguity, fuzzy logic, linguistic variables, fuzzy sets, membership functions, fuzzy set operations, fuzzy expert systems, fuzzification, defuzzification, fuzzy rules, fuzzy inferences. Illustrative examples of engineering applications of fuzzy logic with specific reference to civil engineering.	
Teaching-Learning Process	Black board, POWER POINT PRESENTATIONS and Skill enhancement through SDA

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Books:

1. StuartRussellandPeterNorvig,ArtificialIntelligenceaModernApproach,Thirdedition,PearsonEducation,III edition, 2010.
2. Ben Coppin, Artificial Intelligence Illuminated, Narosa Publications,2014.

Reference Books:

1. David. L. Poole , Alan K. Mackworth, Artificial Intelligence – Foundations of Computational Agents, II edition, Cambridge University Press,2010.
2. Kevin Warwick, Artificial Intelligence-The Basics, Routledge Publications,USA,2012

Web links and Video Lectures (e-Resources):

- http://digimat.in/nptel/courses/video/106106213/L01.html

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level

CO1	Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.	L1, L2
CO2	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.	L2, L3
CO3	Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.	L2, L3
CO4	Identify candidate problems exclusive to a particular engineering discipline that can be addressed under the ambit of AI.	L2, L3, L4
CO5	Demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications.	L3, L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1					X			
CO2					X			
CO3					X			
CO4					X			
CO5					X			

Semester- 3

Data Analytics for Engineers			
Course Code	**22CIM335/22CHT335**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	39 Hr. Theory	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives: The objectives of the course are to:

- Get an overall view of data analysis based on CRISP-DM processmodel.
- Studydataqualityassessmentandvisualizationtechniquesfordatainvolvingtwoattributesandfor higher dimensionaldata.
- Understand principles of modeling by going through various data modelingtechniques.
- Get a detailed account of data preparationphase.
- Study statistical concepts related to dataanalysis.
- Enablestudentstoindependentlyperformdataanalyticproceduresongivendatapertainingtocivil engineering usingExcel.

Module-1

Data and knowledge, criteria to assess the knowledge, descriptive statistics of the data, inferential statistics, exploratory data analysis, knowledge discovery in data bases, data analysis processes, SEMMA, CRISP-DM, methods, tasks and tools.

Teaching-Learning Process	Black board and POWER POINT PRESENTATIONS & web resources

Module-2	
Attribute understanding, kinds of attributes (nominal, interval, ratio types). Characteristics of one dimensional data, location measures, dispersion measures, and shape measures. Characteristic measuresofmultidimensionaldata,dataquality,visualanalyticsofone-dimensionaldata,densityplots, box plots, scatter plots. Correlation and covariance. Methods for multidimensional data (just briefing). Analysis of data pertaining to civil engineering infrastructure/ highwaytechnology.	
Teaching-Learning Process	Black board and POWER POINT PRESENTATIONS & web resources
Module-3	
The four steps of modeling, model classes, black-box models, fitting criteria and score functions, error functions for classification problems, measure of interestingness, closed form algorithm for model fitting. Types of errors. Model validation (briefing on methods). Modeling on the data specific to civil engineering infrastructure/ highway technology.	
Teaching-Learning Process	Black board and POWER POINT PRESENTATIONS & web resources
Module-4	
Selectionofdata,featureselection,selectingtoprankedsubsetofdata,crossproduct,wrapperapproach, andcorrelation-basedfilter.Cleaningdata,improvingdataquality,dealingwithmissingvalues,construct data, providing operability, assuring impartiality and maximize efficiency. Complex data types. Implementation of methods on data specific to civil engineering infrastructure/ highwaytechnology.	
Teaching-Learning Process	Black board and POWER POINT PRESENTATIONS & web resources

Module-5	
Clustering – methods. Hierarchical clustering. Dissimilarity measures; Minkowisci, Euclidian, Manhattan, Chebyshev, and cosine. Deviation measures. Association rules. Brief introduction to self-organizing maps. Implementation of methods on data specific to branch of specialization.	
Teaching-Learning Process	Black board and POWER POINT PRESENTATIONS & web resources

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equalmarks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from eachmodule.
4. Each full question will have a sub-question covering all the topics under amodule.
5. The students will have to answer five full questions, selecting one full question from eachmodule

Suggested Learning Resources:

Text Book:

1. Michel R. Berthold, Christian Borgelt, Frank Hoopner, Guide to Intelligent Data Analysis, Springer- Verlag Publications, ISBN 978-1-84882-259-7, DOI 10.1007/978-1-84882-260-3, London,2010

Reference:

1. Charles M.Zudd, Garry H.Mcchelland, Carry S.Ryan, Data Analysis: A Model Comparison Approach, Routledge Publication, NY,2009.

2. Allan Agresty, An Introduction to Categorical Data Analysis, 2 nd Edition, WileyPublication

Web links and Video Lectures (e-Resources):

- www.kdnuggets.com
- www.kaggle.com
- www.datameer.com

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Demonstrate a sophisticated understanding of the concepts and methods, know the exact scopes and possible limitations of each method and tasks involved. Apply CRISP-DM data analysis processes to civil engineering related data in decision making.	L2
CO2	Apply appropriate data visualization techniques and perform correlation analysis on the real-world data pertaining to allied areas of civil engineering / infrastructure / Highway technology	L3
CO3	Develop appropriate model for the data using the suitable algorithm and validate the so developed model using appropriate validation technique.	l4
CO4	Decide on appropriate method/ technique for data preparation and provide operability byassuringimpartialityandintegritytothegivenreal-worlddatadrawnfromvarioussub domains of civil engineering/ infrastructure/Highway technology	L5
CO5	Perform similarity analysis using similarity metrics and to implement simple clustering techniques of the given data set in one and multiple dimensions.	L6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1					x			
CO2					x			
CO3					x			
CO4					x			
CO5					x			

02-11-2022/V4

Semester III

PROJECT WORK PHASE – 1			
Course Code	22CIM34	CIE Marks	100
Number of contact Hours/Week (L:P:S)	00:06:00	SEE Marks	--
Credits	03	Exam Hours	--

Course objectives:

- Support independentlearning.
- Guide to select and utilize adequate information from varied resources maintainingethics.
- Guide to organize the work in the appropriate manner and present information (acknowledging the sources)clearly.
- Develop interactive, communication, organisation, time management, and presentationskills.
- Impart flexibility andadaptability.
- Inspire independent and teamworking.
- Expand intellectual capacity, credibility, judgement,intuition.
- Adhere to punctuality, setting and meetingdeadlines.
- Instil responsibilities to oneself andothers.
- Train students to present the topic of project work in a seminar without any fear, face audience confidently,enhancecommunicationskill,involveingroupdiscussiontopresentandexchangeideas.

Project Phase-1 Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work.

Seminar: Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected project orally and/or through power pointslides.
- Answer the queries and involve indebate/discussion.
- Submit two copies of the typed report with a list ofreferences.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

At the end of the course the student will be able to:

- Demonstrate a sound technical knowledge of their selected projecttopic.
- Undertake problem identification, formulation, andsolution.
- Design engineering solutions to complex problems utilising a systemsapproach.
- Communicate with engineers and the community at large in written an oralforms.
- Demonstrate the knowledge, skills and attitudes of a professionalengineer.

SOCIETAL PROJECT			
Course Code	22CIM35	CIE Marks	100
Number of contact Hours/Week (L:P:S)	00:06:00	SEE Marks	--
Credits	03	Exam Hours	--

Course objectives:

- Support independentlearning.
- Guide to select and utilize adequate information from varied resources maintainingethics.
- Guide to organize the work in the appropriate manner and present information (acknowledging the sources)clearly.
- Develop interactive, communication, organisation, time management, and presentationskills.
- Impart flexibility andadaptability.
- Inspire independent and teamworking.
- Expand intellectual capacity, credibility, judgement,intuition.
- Adhere to punctuality, setting and meetingdeadlines.
- Instil responsibilities to oneself andothers.
- Train students to present the topic of project work in a seminar without any fear, face audience confidently,enhancecommunicationskill,involveingroupdiscussiontopresentandexchangeideas.

Project Phase-1 Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the societal Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work.

Seminar: Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected societal project orally and/or through power pointslides.
- Answer the queries and involve indebate/discussion.
- Submit two copies of the typed report with a list ofreferences.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

At the end of the course the student will be able to:

- Demonstrate a sound technical knowledge of their selected societal projecttopic.
- Undertake problem identification, formulation, andsolution.
- Design engineering solutions to complex problems utilising a systemsapproach.
- Communicate with engineers and the community at large in written an oralforms.
- Demonstrate the knowledge, skills and attitudes of a professionalengineer.

Semester III

INTERNSHIP			
Course Code	22CIMI36	CIE Marks	50
Number of contact Hours	06 Weeks	SEE Marks	50
Credits	06	Exam Hours	03

Course objectives:

Internship provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,

- To put theory intopractice.
- To expand thinking and broaden the knowledge and skills acquired through course work in thefield.
- To relate to, interact with, and learn from current professionals in thefield.
- To gain a greater understanding of the duties and responsibilities of aprofessional.
- To understand and adhere to professional standards in thefield.
- To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, andconfidentiality.
- To identify personal strengths andweaknesses.
- To develop the initiative and motivation to be a self-starter and workindependently.

Internship/Professional practice: Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

Seminar: Each student, is required to

- Present the seminar on the internship orally and/or through power pointslides.
- Answer the queries and involve indebate/discussion.
- Submit the report duly certified by the externalguide.
- The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and becomeself-confident.

Course outcomes:

At the end of the course the student will be able to:

- Gain practical experience within industry in which the internship isdone.
- Acquire knowledge of the industry in which the internship isdone.
- Apply knowledge and skills learned to classroomwork.
- Develop a greater understanding about career options while more clearly defining personal careergoals.
- Experience the activities and functions ofprofessionals.
- Develop and refine oral and written communicationskills.
- Identify areas for future knowledge and skilldevelopment.
- Expand intellectual capacity, credibility, judgment,intuition.
- Acquire the knowledge of administration, marketing, finance andeconomics.

Semester IV

PROJECT WORK PHASE -2			
Course Code	22CIM41	CIE Marks	100
Number of contact Hours/Week (L:P:S)	00:08:00	SEE Marks	100
Credits	18	Exam Hours	03

Course objectives:

- To support independentlearning.
- To guide to select and utilize adequate information from varied resources maintainingethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources)clearly.
- To develop interactive, communication, organisation, time management, and presentationskills.
- To impart flexibility andadaptability.
- To inspire independent and teamworking.
- To expand intellectual capacity, credibility, judgement,intuition.
- To adhere to punctuality, setting and meetingdeadlines.
- To instil responsibilities to oneself andothers.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchangeideas.

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

02-11-2022/V4

Course outcomes:

At the end of the course the student will be able to:

- Present the project and be able to defendit.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the projecttask.
- Habituated to critical thinking and use problem solvingskills
- Communicate effectively and to present ideas clearly and coherently in both the written and oralforms.
- Work in a team to achieve commongoal.
- Learn on their own, reflect on their learning and take appropriate actions to improveit.